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MONTANA Cooperative Elk-Logging Study

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MONTANA

COOPERATIVE ELK-LOGGING STUDY

Progress Report for the Period

January 1-December 31, 1975

COOPERATING AGENCIES

Region I, U. S. Forest Service
Intermountain Forest and
Range Experiment Station
Montana Department of Fish and Game
Bureau of Land Management
School of Forestry, University of
Montana

STEERING COMMITTEE

Roger Bumstead, Chairman
Ralph Klawitter

Wynn G. Freeman
Don McIntosh
Robert F. Wambach

Submitted by Research Committee:

Eugene O. Allen, F & G, Chairman
Joseph V. Basile, USFS
Reuel G. Janson, F & G
Terry N. Lonner, F & G
L. Jack Lyon, USFS
C. Les Marcum, U of M
Floyd Pond, USFS
Robert Ream, U of M
Darrell Sall, BLM

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MONTANA COOPERATIVE ELK-LOGGING STUDY

January - December 1975

ABSTRACTS

JOB I

PROBLEM ANALYSIS AND COORDINATION

During the year 4 meetings involving one or more members of the research committee were necessary to plan and coordinate project activities. A total of 12 presentations were made by research committee members to advance public awareness and understanding of the elk-logging study and to convey findings to other resource and land managers. One new management recommendation was added, making a total of six. A Wild Kingdom TV program on the study was filmed and shown. Research committee members made a significant contribution to the Elk-Logging-Roads Symposium held in Moscow, Idaho in December. The computerized bibliography was updated and now contains 356 citations. A number of publications were completed. Other activities during the period are reported.

JOB II-A

BURDETTE CREEK-DEER CREEK STUDY

Procedure B-1. Pellet Count Survey.

Pellet group counts on 371 miles of belt transects were completed in late August and September. Distribution of pellets shows a response to the severe winter of 1974-75 and movement away from the Timber Sale on Garden Point. Some movement of elk into Deer Creek following the completion of the timber sale and closure of the road was detected.

Procedures B-2, B-3a and B-3b. Elk harvest, distribution, and food habits.

The 1975 hunting regulations in the study area vicinity were similar to those of 1974, except that there was no early bull season in 1975. Season dates were October 19 - November 2 for either sex, and through November 24 for antlered bulls.

The total number of hunters checked through the three checking stations was 4,565, and the checked elk kill was 102. Both figures are slightly higher than those of 1974. Because of early heavy snow in 1975, more elk were taken on the winter range, and fewer in the high, roadless back country.

The 1975 harvest consisted of 17 spike bulls, 30 branch-antlered bulls, 38 cows and 17 calves. Twenty-four of the 102 elk were taken from the study area, the highest proportion, as well as actual number, since 1970. Four of the 21 marked elk alive in the spring of 1975 were known to have been shot during the 1975 hunting season, one on Eds Creek and 3 in Burdette Creek.

Checking station records for previous years were reviewed and the harvest segment map was revised to show elk harvests from Granite Creek and Howard Creek, two heavily-logged drainages lying near the study area.

Changes in distribution of the elk harvest occurred between years prior to roading (1963 and 1970) and years subsequent to roading (1971-75). Elk checked prior to roading and logging were 2 in Granite Creek, 11 in Howard Creek and 4 in Deer Creek. Since 1970, no elk were taken from Granite Creek in 4 of 6 years and one in each of the other 2; the annual average take from Howard Creek declined from 11 to 5; and the average Deer Creek harvest declined from 4 to less than one.

An aerial count of 201 elk May 1, 1975, on the Fish Creek portion of the study area is the highest of record, but may reflect optimum counting conditions more than a population increase. The actual population may have been considerably higher. Classified counts during winter-spring 1974-75 indicated 40 bulls and 53 calves per 100 cows. These are higher proportions of bulls and calves than counts in other years showed.

Tom Lemke finished his thesis during the spring of 1975. His findings from marked elk, including 10 with radio collars, indicated that some elk remain on the winter range year-long, some move to summer range in the Petty Creek drainage, but the majority summer in the high country between Fish Creek and the Idaho Divide. Calving occurred on or near winter range with no well-defined calving areas. Elk used heavily timbered areas mostly in summer and fall. Hunting triggered some sudden long movements or withdrawal into heavily timbered areas. Elk returned to the winter range during late November and early December. They showed a high degree of fidelity to the same winter range but somewhat less to the summer range. Elk locations averaged 1.4 miles from roads, and were somewhat closer to secondary roads than to primary roads. Distrance to water averaged 0.2 miles. Closure of the Montana Creek road appeared to encourage increased elk use of that drainage.

JOB II-B

LONG TOM CREEK STUDY

The objectives of this study are to determine the environmental requirements of elk and the effects of logging on an elk population in a scattered forest type in Southwestern Montana. As during previous field seasons, elk use of the study area was determined in 1975 primarily from "elk sign" recorded while periodically and systematically walking 62 miles of foot routes.

During 1975 the overall summer and early fall (rut) elk use of the study area was the lowest it has been since field work began in 1972. For the entire fall (September-November) the overall elk use has consistantly declined since the beginning of the study. A relatively late spring and heavy snows in early fall were most likely the largest contributing factor for this low elk use in 1975. These weather conditions caused elk use not only to be restricted to a comparatively short time period, but elk use may have remained more dispersed throughout the area surrounding the study area because of the delayed and prolonged greenup of important forage species. The majority of the logging activity in 1975 was in the form of road construction and did not appear to have much influence on the elk distribution. As in 1973 and 1974, cattle use of the study area significantly influenced the distribution of elk. Not only was there a negative response of elk towards the presence of cattle, but also a strong aversion toward those areas used by cattle even after the cattle had left. Weekly locations of 8 radio-collared cow elk showed how dynamic and extensive elk movements can be. This was true between seasons as well as within seasons. Elk use-habitat type relationships were similar to previous years' findings. Wet sedge parks and broken parks were used heavily by elk during the summer (June-August), while the timber types associated with dry parks were most preferred during the rut and fall months. Specific habitat types and preference ratings are presented. Elk use of cover types within and between habitat types was often specific, changing in both space and time during summer and fall. Preliminary findings of seasonal elk use - cover type relationships within 5 forest habitat types are presented and discussed.

JOB II-D

CHAMBERLAIN CREEK STUDY

The University of Montana, School of Forestry is continuing this study under a contract from the BLM. The major objective of the study will remain the same, however there will be some changes in investigational techniques.

The most heavily used habitat types by elk in the study area during the summer of 1975 were the *Abies lasiocarpa/Menziesia ferruginea, Abies lasiocarpa/Xerophyllum tenax (Vaccinium globulare* phase), and the *Pseudotsuga menziesia/Calamagrostis rubescens* types respectively. When use was compared to plant community availability, elk preferred the *Abies lasiocarpa/Vaccinium globulare, Pseudotsuga menziesia/Calamagrostis rubescens,* and *Pseudotsuga menziesia/Festucaidahoensis* habitat types most. During 1975, elk use was greatest at lower elevations, on dry slopes, near the northern end of the study area.

ELK MANAGEMENT RECOMMENDATIONS FOR THE CONSIDERATION OF LAND MANAGERS

INTRODUCTION

The cooperative elk-logging study has concluded its 6th year and study segments are in various stages of completion.

Job I. Coordination. This is an on-going job and will continue for the life of the project.

Job II-A. Burdette Creek. Data continue to be collected in the post-logging phase.

Job II-B. Long Tom Creek. This job is just starting the logging phase.

Job II-C. Sapphire Mountains. A final report will be prepared during the next report period.

Job II-D. Chamberlain Creek. This job is just completing the pre-logging phase.

Jobs III-A-1and A-2. Judith and Ruby Road Closures. The final report is in the final editing phase.

Job III-B. Disturbed Areas. A final report will be prepared during the next report period.

Job IV. Spotted Bear. This job is completed and recommendations have been submitted to the U. S. Forest Service.

Certain findings appear to be firmly based and worthy of consideration. In order that management can benefit from the study effort prior to the final report, the research committee has been directed by the steering committee to formulate tentative management recommendations or guidelines based on findings-to-date.

It is not intended that these recommendations be broadly applied throughout the forests of Montana. Likewise, it is not intended that they be considered the "last word" or an attempt to dictate management practices to public agencies or private corporations. It is intended that they be considered a portion of the wildlife input that should be evaluated, along with many other values and inputs, in the planning of all timber sales and road construction projects. If a recommendation fits the situation, in an identified elk-use area, its implementation will help minimize any detrimental impact on the elk in the area. The recommendations merely represent an attempt by the study team to place significant findings in the hands of management as the research study progresses.

The following recommendations, although based on the best information presently available, are considered tentative and subject to change; the hazards of extrapolation must be recognized. They may not apply to certain local situations and literal application should not be substituted for detailed, joint discussions and on-the-ground inspections by timber and wildlife managers and other resource specialists.

SECURITY AREA RECOMMENDATION

Research Finding:

During active road building and logging, elk have responded by moving to surrounding ridgelines and further. The distance moved apparently depends on a variety of factors including size of the drainage area encompassed by logging, intensity and season of logging activities, and disturbance on the ridgelines.

Displacement of elk, which is considered temporary, has been detected as far as four miles from the area of summer logging activity. In one study, herd displacement was to an adjacent third order drainage and then beyond that drainage when the ridgeline was disturbed. In another investigation, displacement was down a ridgeline for two miles through undisturbed timber and over a point. In both cases, topographic features provided a line-of-sight barrier between elk and the logging activity.

Recommendation: Planning for timber sales in elk summer range should include provision of a security area immediately adjacent to the disturbed area during the active logging and/or road building period.

Discussion: Security for elk is still an undefined concept, but it appears that an area adequate to reduce long distance displacement of animals by timber sale activities should satisfy the following minimum criteria:

-- it must be adjacent to and easily reached by elk dispersing from the disturbed area, and the intervening ridgeline must be protected from all mechanical activities.

-- it should contain a fairly large acreage of forest cover at the head of a drainage. The particular acreage required will depend on cover quality, but the areas available to elk in one study were about 5,000 acres, and this size also approximated the average summer range (June-August) used by several radio instrumented animals in another study.

Application of the security area concept on the ground must be based on individual situations as they exist. There is no way to specify an exact acreage required for all elk everywhere.

Several available security areas are considered far superior to a single area, and where consecutive timber sales progress from one drainage to the next, it is suggested that activity be confined to a single drainage at a time with completed sales being converted to security areas as quickly as possible.

HABITAT TYPE-MOIST SITE RECOMMENDATION

Research Finding:

Within the various study areas, findings-to-date indicate that during the summer months (June-September) elk prefer those sites at the head of drainages bordering streams or marshy meadows, or occupying moist swales or benches. All of these sites are characterized by their close proximity to areas where water is present, on or near the surface, for all or part of the summer period. Both east and west of the Continental Divide these sites are usually found within the *Abies lasiocarpa* habitat type series. East of the Continental Divide, the dominant vegetative components of these sites are Subalpine fir, Whitebark pine, spruce, or combinations thereof. These sites are usually found within the *Abies lasiocarpa/Calamagrostis canadensis, Abies lasiocarpa (pinus albicaulis)/Vaccinium scoparium, Abies lasiocarpa/Vaccinium scoparium (Thalictrum occidentale* phase), and *Abies lasiocarpa/Luzula hitchcockii* habitat types as described by Pfister, et al. (1975). In western Montana these moist sites are generally found within the more hydric parts of the *Abies lasiocarpa/Luzula hitchcockii (mensiesia* phase), *Abies lasiocarpa/Clintonia uniflora, Abies lasiocarpa/Menziesia ferruginea,* and the *Abies lasiocarpa/Galium triflorum* habitat types described by Pfister, et al. (1975).

Recommendation: Two general types of summer range situations exist in Montana. The first type occurs where moist sites are found in close proximity to each other, and in combination with other habitat components they comprise a rather large area, which is heavily used by elk. Another type of situation exists, where moist sites are not in close proximity with one another, but evenly distributed over the summer range. While this latter situation may support a large number of elk in total, each moist area may be used by relatively fewer animals. These two situations are not mutually exclusive, so both types can occur on portions of the same summer range. Where the first situation exists, an area large enough to maintain the overall integrity of the habitat components to be managed should be determined by an on -the-ground inspection by land and wildlife managers and other appropriate resource specialists. A similar recommendation to protect moist sites which are relatively far apart but evenly distributed over a summer range, as well as a security zone of cover around each site, may be impractical. However, it should be recognized that continual loss of these small units and their juxtaposition in the forest could in time have a substantial adverse impact on a local elk herd. Therefore, as many as possible of these sites should be identified and withdrawn from treatment, along with a peripheral zone to provide continuous

cover with the uncut forest. New or planned roads passing near these sites should be closed to summer-fall vehicular traffic, except perhaps for light intermittent administrative use, following logging in the area. Roads which already occur near moist areas of either type described above should be closely evaluated for travel restrictions.

Discussion: Moist sites (wet sedge meadows, bogs, seeps, etc.) have been identified as a very important component of elk summer range especially when these sites occur within the *Abies lasiocarpa* climax series.

Preferred elk summer range exists when these moist sites are interspersed with other necessary habitat components including a diversity of timber types and densities, and perhaps dry broken or open parks, especially near drainage heads or other topographic entities where these conditions are found.

In terms of the biology of elk, sites near water are important because the forage they produce is heavily utilized by elk prior to the breeding season. Other studies indicate that nutrition obtained by the animals during this period is a significant factor in reproduction. Generally, west of the Continental Divide early to mid-seral stages of the habitat types named above produce more forage. However, mature stands on moist sites also provide important cover, and removal of such stands may result in a decline or loss of elk use in the area.

ROAD LOCATION RECOMMENDATION

Research Finding:

Location and density of roads, and the use made of those roads, may be disturbing to elk depending on intensity, type, and season of use. Elk travel routes normally cross ridges through saddles and are usually easy to identify. When these saddles are opened up they tend to be avoided as crossing places for elk. Disturbance by road construction or hunting season traffic has resulted in declines or elimination of elk use in such places. Elk have indicated a preference for crossing ridges in sections where visibility is relatively low and security relatively high, often where dense timber is present. Alteration of such crossing areas can be especially critical during the hunting season.

Recommendation: During the location and design of transportation systems, existing elk movement patterns and probable elk crossing areas should be identified and provisions made to provide security for unimpeded movement. Where possible, several alternate routes should be considered. Primary considerations should be given to:

a. maintaining frequent dense cover areas adjacent to the road;
b. avoiding saddles or low divides frequented by elk for crossing ridges between drainages;
c. maintaining cover at places where game trails cross roads;

d. utilizing a low standard slow speed, single track road that lays lightly on the ground in important elk areas; and
e. road right-of-way slash should be disposed of so as to not inhibit elk movement.

ELK-CATTLE RECOMMENDATION

Research Finding:

Findings from investigations to determine seasonal elk distribution have indicated that the presence and distribution of domestic cattle has substantially influenced the distribution of elk on summer range. Systematic observation revealed a significant tendency for elk to avoid cattle. Movement of cattle into areas being used by elk caused displacement of the elk into areas where cattle had not been or would not be.

Recommendation: Road construction and/or other associated timber harvest activities occasionally "open up" new areas for grazing or alter existing cattle grazing allotments on elk summer ranges, increasing the potential for elk-cattle interaction in such areas. The effect of every proposed timber sale on elk and livestock management objectives and programs should be evaluated. If potential elk-livestock conflicts are identified as a result of proposed timber harvest, the conflict should be resolved on a case-by-case basis.

HABITAT TYPE-COVER TYPE RECOMMENDATION

Research Finding:

While the habitat type classification system gives a reasonable description of forest community composition and ecological potential, the structural characteristics, or cover type, can vary within habitat types by location and over time. Also, seral stages in different habitat types may be structurally similar. Elk use of cover types within and between habitat types is often specific, changing in both space and time during summer and fall. For example, moist sites may be highly preferred from June through September but avoided in October and November while the relatively advanced seral stages and the more dense stands of timber may not be as important June through August as in the fall months.

Recommendation: Findings of this study indicate that plant community structure, or cover type, is often a more important factor than community composition, or habitat type, in determining elk use during summer and fall. Management efforts based on what's going to be there (habitat type) should be well coordinated with an awareness of what's there (cover type) and a knowledge of spatial and temporal differences in elk use within and between habitat types.

Discussion: Preserving or maintaining the interspersion, diversity, and juxtaposition of various habitat types and their successional stages or cover types cannot be overemphasized as an important elk management tool on important elk spring, summer, and fall range. When an attempt is made to quantify elk use-habitat type relationships it is very difficult to differentiate between the importance of individual habitat types and the importance of the overall interrelationships of these types with one another, not to mention the various stages of development or cover types within each habitat type. Important or key areas for elk must be identified before or during the planning and implementation of silvicultural practices.

CLEARCUTS RECOMMENDATION

Research Finding:

Graphic analyses of the number of elk pellet groups found inside clearcuts in eastern and western Montana have identified seven different variables that influence elk use of openings. All are important in some degree, but relative importance can vary depending on the environment available to elk and elk behavioral patterns associated with their environment.

In eastern Montana, for example, tree cover occupies a smaller proportion of the winter range and there is a more distinct separation between winter and summer ranges. Elk make relatively greater summer use of clearcuts at higher elevations as compared to western Montana where some elk remain on the winter range year around.

Throughout Montana elk range, slash within the opening and dead and down timber in the surrounding uncut forest reduced elk use. A preference for small openings was indicated, particularly in western Montana, but cutting units as large as 100 acres may be acceptable under some circumstances.

Elk response to the growth of vegetation inside an opening differs between eastern and western Montana. The differences could be related to vegetation palatability but are more probably determined by the habitual feeding pattern of animals. Where new growth consists of both trees and shrubs and elk feed on browse, elk use of openings increases until vegetation is at least four feet high. Where new growth is mostly trees and elk feed primarily on grasses and forbs, elk use of openings declines as vegetation height increases. As a corollary to this indicated preference for openings lacking tall cover, eastern Montana elk responded to additional security provided by good cover adjacent to the opening and, further, demonstrated a substantial positive response to openings without motor vehicle access.

Recommendation: On the basis of available data, it is not possible to demonstrate that clearcuts in any configuration are clearly beneficial to elk. Neither is it possible to demonstrate detrimental effects if the openings satisfy certain criteria:

(1) Slash cleanup inside clearcuts should reduce average slash depth below 1.5 feet. Slash in excess of 1.5 feet will reduce elk use by more than 50 percent.
(2) Small openings appear to be preferred, but openings up to 100 acres may be acceptable where the adjacent forest is relatively free of understory debris and security is adequate.
(3) Security cover is required if elk are to enter any opening. In western Montana, some cover is provided by vegetation growth as the opening becomes older; but in eastern Montana elk prefer young openings and security should be provided by designing clearcuts so that the best available cover occurs at the edges. As a corollary, thinning adjacent to clearcuts is not recommended.
(4) Additional security, which will significantly increase elk use of openings in eastern Montana, can be provided with appropriate road closures.

WINTER RANGE RECOMMENDATION

Research Finding:

Elk on winter range have been shown to prefer dense timber stands and larger trees for bedding cover. These bedding sites are usually in close proximity to a feeding area such as a south-facing slope with a good stand of browse or perennial grass. Timbered areas which recieved moderate to heavy elk-bedding use prior to logging were not used for bedding during winters following heavy selection logging. Elimination of these preferred bedding sites can subject elk to a decrease in energy intake and an increase in energy output because of increased travel between suitable bedding and feeding sites, lowered insulating value of bedding cover because of loss of large trees, and use of inferior food sources closer to new bedding sites.

Recommendation: Timber harvest is not recommended on important well used elk winter ranges. Selective logging of the large trees which are important for energy conservation is particularly detrimental. Also, timbered areas adjacent to natural grassland openings on winter ranges are critical resting areas for feeding elk, and should not be logged.

It is conceivable that logging can improve winter range on extensively timbered areas which support only limited numbers of wintering elk. Improvement of suboptimum winter ranges where forage conditions are very limiting could perhaps be done by removing or reducing the overstory in small patches on southerly slopes at wintering elevations, while leaving adjacent dense timber stands on benches and finger ridges to provide cover and bedding sites. The margin for error is narrow on winter range, so planned operations must be considered on a site by site basis, with the primary emphasis placed on animal habitat rather than timber production. Logging slash hinders elk movements, and cleanup of debris which results from cutting should be as complete as possible.

ROAD CLOSURE RECOMMENDATION

Research Finding:

Two phases of the project involved area closures that restricted motor vehicles to a few selected roads during the hunting season.

The Judith Road Closure Study indicated that travel restrictions did not change elk distribution or temporal distribution of hunters. Apparently this area closure was not necessary to "protect" elk where escape cover was adequate and well distributed (at least 2/3 cover to 1/3 open). Hunters spent more time walking; consequently, they reported seeing and killing more elk under the restrictions than during the unrestricted seasons. Their unsolicited comments showed a preference for limited access because of the "higher quality" hunt it afforded.

The Ruby Road Closure Study, on the other hand, showed that area closures can cause significant changes in elk distribution and hunter use of the area. This area was characterized by a relatively open, broken forest with gentle terrain and easy access (1/3 cover to 2/3 open). During seasons of restricted travel, elk stayed in the restricted area longer and in greater numbers than during preclosure seasons. This resulted in a greater season-long uniformity (but not total amounts) of hunting pressure, elk sightings, and elk harvest. Hunters also spent more time walking during the restriction period. A trend toward these same changes was noted in the unrestricted travel zone of this study area. Most hunters interviewed felt that the area closure had increased the quality of their hunt.

Recommendation: Elk management goals and objectives should be clearly defined before imposing travel restrictions, being especially cognizant of the following:

I. Restrictions will:
   1. increase the time spent walking by hunters, and as a result:
      a. increase the number of animals seen.
      b. possibly increase the kill.
   2. generally be accepted as providing a higher quality hunt.
   3. make retrieval of killed animals more difficult.

II. Where cover is good (at least 2/3 of total area) and well interspersed, restrictions will probably have little effect on elk distribution.

III. Where cover is poor (1/3 or less of total area) restrictions will:
   1. reduce harassment and emigration of elk.
   2. probably reduce the early elk harvest, but increase the uniformity of harvest throughout the season.

Discussion: Road density and pattern, including off-road travel, play an important role in determining the security level an area provides to elk during the hunting season. An area with sparse cover and low road density may provide as much security as the same sized area with heavy cover but with high road density. For example, in the Ruby portion of this study the security level was significantly increased by reducing the road density and by eliminating off-road travel. Road density and cover quality are *both* important when considering adequate elk security during the hunting season.

Also, road closures in areas that change elk distribution in space and/or time must also change elk distribution in the adjacent area(s) (an elk can't be in two places at the same time). Therefore, closures may benefit hunters in one area at the expense of hunters elsewhere.

JOB I

PROBLEM ANALYSIS AND COORDINATION
PROGRESS REPORT FOR PERIOD JANUARY 1 - DECEMBER 31, 1975

INTRODUCTION

The objectives of this job are to identify the basic conflicts between timber harvest and elk ecology in the various forest types of Montana and to plan and coordinate research efforts. While these are basically unproductive activities from the viewpoint of findings, they are necessary for the smooth operation of the project and to insure that all objectives are fulfilled.

Committees

The project steering committee for 1975 included the following members:

Region I, USFS	Roger Bumstead, Chairman
Montana Dept. of Fish & Game	Wynn G. Freeman
Bureau of Land Management	Don McIntosh
Intermountain Forest and Range Experiment Station	Ralph Klawitter
School of Forestry, University of Montana	Robert Wambach

The project research committee for 1975 included the following members:

Montana Dept. of Fish & Game	Eugene O. Allen, Chairman
	Reuel G. Janson
	Terry N. Lonner
Intermountain Forest and Range Experiment Station	Joe Basile
	L. Jack Lyon
Bureau of Land Management	Richard Ellison
Region I, USFS	Floyd Pond
School of Forestry, University of Montana	C. Les Marcum
	Robert Ream

ACTIVITIES

During the year 4 meetings were necessary for project planning and coordination:

Date	Location	Meeting
Febuary 10-11, 1975	Missoula	Research Committee Meeting
March 5-6	Bozeman	Steering Committee Meeting
May 22	Bozeman	A portion of research committee to discuss Spotted Bear Recommendations
June 18	Spotted Bear	Steering Committee summer meeting

During the year 8 talks or programs were presented to various groups:

Date	Organization	Speaker
March 6, 1975	U of M Wildlife Society, Missoula	Janson
April 7	R-1 silviculture training class, Missoula	Lyon
May 13	Interagency meeting, Salmon, Idaho	Lonner
May 19	C.S.U. Senior field trip, Missoula	Lyon
May 23	Targhee Forest rangers and staff, Island Park, Idaho	Allen, Lyon
July 10	Missoula Exchange Club	Janson
September 10	Anaconda Sportsmens Club	Lonner
December 1	Deer Lodge Forest personnel, Butte	Lonner

During the 1975 report period, project personnel were responsible for eight publications:

1975 Publications

Cooperative Elk-Logging Study

Lonner, T.N. 1975. Elk use-habitat type relationships on summer and fall range in Long Tom Creek, southwestern Montana. Presented at the Elk-Logging-Roads Symposium, Moscow, Idaho, December 16 & 17, 1975. 25 pp.

Lyon, L.J. 1975. Coordinating forestry and elk management in Montana: initial recommendations. Trans. N. Amer. Wildl. Conf. 49:193-201.

Lyon, L.J. 1975. Elk use of clearcuts in western Montana. Handout for R-1 U.S.F.S. Ranger Districts. 10 pp.

Lyon, L.J. 1975. Big game use of clearcuts in western Montana. Presented at Elk-Logging-Roads Symposium in Moscow, Idaho. December 16 & 17, 1975. 10 pp.

Marcum, C.L. 1975. Summer - fall habitat seclection and use by a western Montana elk herd. Ph.D. Thesis. U.of Montana, Missoula. 188 pp.

Marcum, C.L. 1975. Habitat selection and use during summer and fall months by a western Montana elk herd. Presented at the Elk-Logging-Roads Symposium, Moscow, Idaho, December 16 & 17, 1975. 22 pp.

Research Committee 1975. Cooperative elk-logging study plan. 19 pp.

Research Committee 1975. Fifth annual cooperative elk-logging study progress report, January 1 - December 31, 1974. 146 pp.

The 1975 annual summer field tour was June 18 to the Spotted Bear District of the Flathead Forest in northwestern Montana. Purpose of the trip was for an on-the-ground inspection of two management units which had been selected for elk habitat improvement through timber harvest practices. Following the inspection, management guidelines and recommendations were prepared by the research committee and presented to the District Ranger for his consideration. (These recommendations were included in the 1975 annual progress report).

The cooperative Elk-Logging Study was the topic of a Wild Kingdom TV program shown in December. Footage for the program was filmed on March 12 and July 14, 15, 16, 18 and 19, 1975.

Elk-Logging-Roads relationships were the subjects of a symposium held in Moscow, Idaho, December 16 and 17, 1975. The symposium topic was timely as evidenced by an attendance of more than 400 persons. Many of the presentations were interesting and of high quality and the meeting provided an excellent opportunity to compare our findings with those of other researchers and to broaden our perspectives concerning the elk-logging problem in general. The Montana Cooperative Elk-Logging Study was well represented and presentations by three research committee members were included on the program.

The computerized elk and logging bibliography (Famulus) was updated and now contains 356 citations. This bibliography is on magnetic tape and is available for distribution by writing to: Terry Lonner, Montana Department of Fish and Game, Research Section, Box 5, M.S.U., Bozeman, MT 59715

A sixth management recommendation dealing with elk and cattle interaction on summer range was added. Recommendations are considered tentative and will be revised as research findings dictate.

The initial 5-year cooperative agreement expired and a new one was signed. At this time it is uncertain whether or not all phases of the study will be completed within the current agreement period which ends in June of 1980.

Submitted by: Eugene O. Allen

JOB II-A
Procedure B-1

CONDUCT ANNUAL PELLET COUNT SURVEYS TO DESCRIBE ELK DISTRIBUTION PATTERNS WITHIN THE BURDETTE CREEK - DEER CREEK AREA

Progress Report for the Period January 1 - December 31, 1975.

INTRODUCTION

Pellet distribution surveys in Burdette Creek, Deer Creek and adjacent drainages were initiated in the fall of 1970 to (1) describe elk distribution patterns before, during and after the timber sale in Deer Creek, and (2) to describe elk use of the available environment. Due to budgetary constraints only the distribution patterns were examined in the 1975 data and reported here.

METHODS

A complete description of the methods used to collect pellet-count data was presented in the 1973 progress report. In brief, the technique involves recording pellet groups in four-foot belt transects located along the contour at 500-foot intervals throughout the study area. Transects are divided to provide information for each 40-acre block and each aspect change within a forty. In 1975, transects were surveyed between 25 August and 10 September.

RESULTS

Table 1 presents a summary of pellet group data for each year since 1970. In 1975, an 11 percent decline in pellet groups per mile was recorded, but this is probably not indicative of any real decline in the elk population virtually all of the decline in pellet groups took place in the very old group category (table 2). Analysis of attrition rates for pellet groups has not been attempted, but the data in table 2 suggest that disappearance of pellet groups is probably determined by an appropriate combination of weather factors at relatively infrequent intervals.

Table 1.--Numbers of elk pellet groups counted by year, miles of transect and pellet groups per mile, 1970-1975.

Year	Total Pellet Groups Counted	Total Miles of Transect	Pellet Groups per Mile
1970	10,830	277.2	39.1
1971	9,651	320.5	30.1
1972	7,856	324.7	24.2
1973	9,048	383.9	23.6
1974	10,126	388.3	26.1
1975	8,573	371.2	23.1

Table 2.--Pellet groups per mile by age class and year, 1970-1975.

Year	Age Class			
	Fresh	New	Old	Very Old	Total
1970	1	9	19	10	39
1971	1	5	14	11	30
1972	0	3	10	11	24
1973	0	3	9	12	24
1974	0	2	11	13	26
1975	1	4	12	6	23

ELK DISTRIBUTION

Table 3 presents a six-year summary of elk distribution trends for nine subunits of the Burdette Creek - Deer Creek study area. In each subunit, the number of pellet groups per mile is expressed as a percentage of the average number of pellet groups per mile for the whole study area.

Table 3.--Elk distribution trends, pellet groups per mile as a percentage of the mean for the study area, 1970-1975.

Subunit	Year					
	1970	1971	1972	1973	1974	1975
Wall Canyon to Lion Creek	78	95	105	68	107	122
Deer Creek above Wall Jct.	68	56	45	34	26	32
Eds Creek and Gus Creek	100	80	78	112	72	62
Wig, Owl and Upper Hydes	90	108	82	66	74	119
Burdette Creek above 5000 feet	70	92	61	101	84	70
Burdette Creek below 5000 feet	168	173	210	195	215	175
Johns Creek and S. Fork Petty	95	76	87	100	87	82
Lower Hyde, Burdette, Lupine	79	73	80	55	59	91
Upper Lupine Creek	114	125	141	147	167	174
Pellet groups per mile	39	30	24	24	26	23

As noted in previous reports, winter weather was one of the significant factors influencing elk distribution patterns as indicated by pellet groups. The winter of 1974-75 started with relatively mild conditions, but heavy snowfall in 1975 resulted in overall above average severity. In addition to weather influences, the Garden Point timber sale was activated at the lower end of Johns Creek and the South Fork of Petty Creek; previously active logging along Fish Creek was terminated; and the Deer Creek road system was closed for the entire year.

This combination of events produced a number of changes in elk distribution that appeared to be more or less consistent with expectation:

1. Weather
   a. Severe winter weather brought on increased use of winter ranges in Wall - Lion, Wig - Owl, Hyde - Lupine and Lupine Creeks. In all but the latter drainage the cessation of logging activity along Fish Creek may also have contributed to greater use by elk.
   b. Corollary to the increased use noted above, elk use of areas above 5000 feet in Eds - Gus and Burdette declined.
   c. The decline of elk use below 5000 feet in Burdette Creek was, however, unexpected. It may eventually be possible to demonstrate that some combination of events related to the initially mild but eventually severe winter weather prevented full use of the Burdette Creek winter range, but at this point no satisfactory explanation for the decline can be suggested.
2. Logging activity
   a. Cessation of logging activity along Fish Creek may have contributed to increased use of westerly aspects as noted in 1.a.
   b. The Garden Point sale between John's and S. Fork Petty Creeks produced a decline in the use of that area and may also have contributed to the increases in upper Burdette Creek and upper Lupine Creek
   c. The downward trend of elk use in Deer Creek has apparently been reversed. Elk use of the drainage is still less than half that recorded prior to logging, but the 1975 count was 23 percent greater than the 1974 count.

Plans for 1976 include continuation of the road closure in Deer Creek and of the sale in Garden Point. Pellet counts will be conducted in late August and early September.

Submitted by: L. JACK LYON

JOB II-A
Procedures B-2, B-3.a and B-3.b
ELK HARVEST DISTRIBUTION AND FOOD HABITS
Progress Report for the Period
Jan. 1, 1975 - Dec. 31, 1975

INTRODUCTION

The collection of hunting and harvest data at three checking stations was continued for the 6th consecutive year. Heavy snow fell during the first week of the hunting season,in contrast to mild dry October weather in 1974. This initiated an early movement of elk toward winter range.

Tom Lemke concluded the elk movement study during the spring of 1975. Movements were determined by monitoring elk instrumented with radio receivers. Lemke's data also provided further information on seasonal ranges and their physical and vegetative characteristics.

METHODS

Three checking stations were operated at the same locations and approximately the same time periods as in 1970-74. The Lolo and Fish Creek stations were operated every day during the first eight days of the either-sex season, and on weekends thereafter. The Petty Creek station was operated only on weekends throughout the season.

The number of hunters and the sex, age and locations of elk and deer kills were recorded. Occasional flights and ground surveys were made to document distribution, numbers, and sex-age composition of the elk herd.

Elk previously trapped, ear-tagged, neck-banded and fitted with radio transmitters were monitored during periodic ground and aerial surveys. The location, topographical features and cover type of each elk observation were recorded.

Checking station records of previous years were reviewed, and some changes were made in the harvest segments shown in Figure 1. More accurate determinations of kill locations resulted in fewer elk shown killed in the Deer Creek drainage in 1963 (four) than was shown in previous reports (seven). The North Lolo segment (No. 7) as shown in previous reports, was subdivided on the Graves Creek-Petty Creek road and on the Lolo Hot Springs-Fish Creek road, so that kills from the Granite Creek and Howard Creek areas could be shown separately. This resulted in two additional segments (Nos. 8 & 9) and changed the number of the South Lolo Creek Segment to #10 as shown in Figure 1.

FINDINGS AND DISCUSSION

Hunting Pressure and Elk Harvest

The 1975 elk hunting regulations in the vicinity of the study area were similar to those of 1974, except that there was no early bull season in 1975, the either-sex season was three days longer, and the antlered bull season was one week longer. Season dates were October 19 - November 2 for either sex, and through November 24 for antlered bulls.

The total number of hunters checked through the Lolo, Fish Creek and Petty Creek stations was 4565 in 1975, compared to 4541 in 1974. The total number of elk checked was 102 in 1975 compared to 96 in 1974. Heavy snow in late October did not increase the total kill greatly above the 1974 harvest, but did change the distribution. Fewer elk were taken on summer range in the roadless back country of the north and west forks of Fish Creek, while more were taken on winter range areas, particularly in the Study Area (Segment #5 on the map in Figure 1). Tables 1 & 2 show a breakdown of the checked harvest by sex-age classes and areas. Of the 102 elk, 17 were spike bulls, 30 were branch-antlered, 38 were cows, and 17 were calves. Twenty-four elk were taken from the study area. This is 24% of the total checked kill, the highest kill from the study area since 1970.

Revised harvest figures for each year are shown in Table 3. Total harvests have varied more as a result of variation in hunting regulations and weather than other influences. However, some change in harvest distribution appears to have occurred as a result of roading and logging. In 1963 two elk were reported killed in Granite Creek, 11 in Howard Creek and 4 in Deer Creek. Considerable logging in Granite and Howard occurred before 1970, and also since 1970. No elk were checked from Granite Creek in 1970, 1972, 1974 and 1975, and only one in 1971 and 1973. Eleven elk were checked from Howard Creek in 1970, 4 in 1971 and 1972, one in 1973, 10 in 1974 and 5 in 1975. The increased number in 1974 may have been associated with more access created by new logging roads. Deer Creek was unroaded and unlogged, except in the lower end, until 1970. Four elk were checked from there in 1963 and again in 1970. Roading began in 1970 and logging in 1971. Elk checked from Deer Creek were reduced to none in 1971, 1972 and 1975. Two were recorded in 1973 and one in 1974. This agreed with pellet group counts which show less elk use in Deer Creek since logging began. Four of the 21 marked elk alive in the spring of 1975 were known to have been shot during the 1975 hunting season. These were cow C^1 on Deer Peak in Ed's Creek, and cows #1, 4, and 7 in Burdette Creek. The identities are as listed by Lemke (1975) and Janson (1975).

Population Trend and Herd Composition

An aerial count on May 1, 1975 resulted in a count of 201 elk in the portion of the study area in the Fish Creek drainage. This is the highest count of record, but may reflect optimum counting conditions more than an actual increase in the elk herd. The distribution of these elk is shown in Figure 2. Previous counts were 151 in April, 1971; 133 in December 1971; 141 in April, 1973; and 150 in December 1973. During the 1975 count, 12 collared elk were observed. Records show there should have been 21 collared elk in the population. Application of the Lincoln Index indicated a total population of 350. Lemke (1975) estimated 225-300 elk in the area during late winter and early spring.

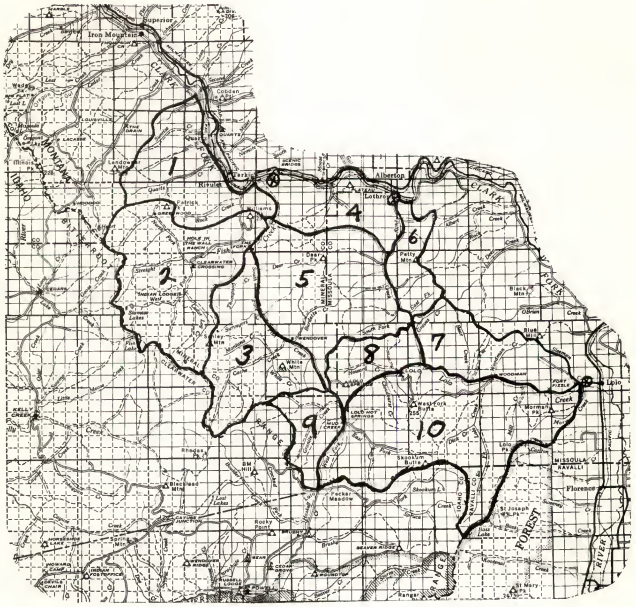


Figure 1. Elk harvest segments in area checked by Lolo Creek, Fish Creek and Petty Creek checking stations

⊗ - Checking station location
1 - Quartz Creek-Meadow Creek
2 - North Fork Fish Creek
3 - West Fish Creek
4 - Sawmill Gulch
5 - Study Area
6 - East Petty Creek
7 - North Lolo Creek
8 - Howard Creek
9 - Granite Creek
10 - South Lolo Creek

Table 1. Elk harvest from Lolo, Fish Creek and Petty Creek by sex-age classes and locations, 1975

Segment Number	Segment Name	Spike bulls	B.A. bulls	Cows	Calves	Total
#1	Quartz-Rivulet	0	1	0	0	1
#2	North Fork Fish Creek	6	8	14	6	34
#3	West Fish Creek	0	4	1	1	6
#4	Sawmill Gulch	1	1	1	0	3
#5	Study area	5	10	8	1	24
#6	East Petty Creek	2	0	2	2	6
#7	North Lolo Creek	0	2	3	5	10
#8	Howard Creek	2	2	1	0	5
#9	Granite Creek	0	0	0	0	0
#10	South Lolo Creek	1	2	7	2	12
Misc:	Deep Creek			1		1
	Total	17	30	38	17	102

Table 2. Sex-age composition of harvested elk checked from the vicinity of the Burdette Creek Study Area

Sex-age class and ratios	1963	1970	1971	1972	1973	1974	1975
	No. of Elk						
Yearling Bulls	10	18	14	6	16	14	17
Older Bulls	34	43	50	39	49	36	30
Total Bulls	44	61	64	45	65	50	47
Cows	58	54	34	23	47	30	38
Calves	19	11	10	8	16	14	17
Total Elk	121	126	108	76	128	94	102
Yrlng/100 Older Bulls	29	42	28	15	33	39	57
Bulls/100 Cows	76	113	188	196	138	167	124
Calves/100 Cows	33	20	29	35	34	47	45

Table 3. Distribution of harvested elk checked from the Lolo, Fish Creek and Petty Creek areas

Segment No.	Location	1963*	1970	1971**	1972	1973	1974	1975
#1	Quartz-Rivulet	4	4	2	0	3	0	1
#2	N.Fk. Fish Creek	28	52	20	35	54	43	34
#3	West Fish Creek	9	7	13(+4)	5	7	4	6
#4	Sawmill Gul.	0	2	2(+1)	2	2	2	1
#5	Study Area: (Tot)	16	32	15(+19)	4	14	6	24
	Beaver Slough	0	0	0	0	0	0	1
	Wall Canyon	0	0	0	0	0	1	0
	Deer Creek	4	4	0(+1)	0	2	1	0
	Deer Peak	2	0	1	0	0	1	0
	Wig-Lion	0	4	1	1	2	0	1
	Owl-Hyde	0	3	4(+4)	0	1	0	1
	Burdette Creek	7	5	1(+11)	1	2	0	6
	Lupine-Sullivan	0	5	2(+3)	0	1	1	4
	Wagon Mtn. Road	1	3	0	1	1	0	2
	S. Fork Petty	1	7	1	0	2	1	5
	Garden-Johns	1	0	0	0	0	0	0
	Gus Creek	0	0	1	0	0	0	2
	Eds Creek	0	1	1	0	1	1	2
	W.Fk. Petty Creek	0	0	3	1	2	0	0
#6	E. Petty Creek	1	6	6	4	8	9	4
#7	N. Lolo Creek	13	2	6(+1)	11	4	5	10
#8	Howard Creek	11	11	4(+1)	4	1	10	5
#9	Granite Creek	2	0	1	0	1	0	0
#10	South Lolo	9	7	7	6	14	9	12
	Miscellaneous: Tot)	27	2	6	5	20	8	5
	Tank-Corral	1	0	0	3	5	3	0
	O'Brien-Deep Cr.	0	0	1	2	6	1	1
	Misc. Fish Cr.	10	1	1	0	5	3	2
	Misc. Petty Cr.	14	1	0	0	4	1	2
	Misc. Lolo Cr.	2	0	4	0	1	0	0
	Totals	120	125	82(+26)	76	129	96	102

* Data from Frenchtown and Lolo checking stations; 1970-75 data are from Lolo Creek, Fish Creek and Petty Creek stations

** Figures in parentheses are unchecked kills reported by Joe Bohne, U of M graduate student

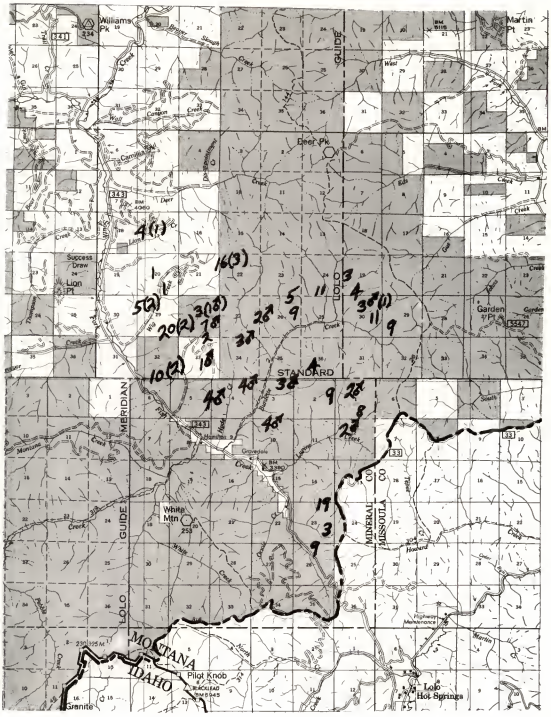


Figure 2. Numbers and distribution of elk seen during aerial survey, May 1, 1975. Numbers in parentheses are neck-banded elk included in first figure,

Lemke (1975) observed cumulative totals of 459 cows 242 calves 60 spike bulls, and 129 branch-antlered bulls during the winter of 1974-75. His ratios were 46 spikes per 100 branch-antlered, 40 bulls per 100 cows and 53 calves per 100 cows. These proportions of bulls and calves are higher than those from other counts in the area (Janson, 1975).

Movements and Seasonal Ranges

Elk movements and use of seasonal ranges were determined by Lemke (1975) from 383 relocations of 14 marked elk, including 10 elk with functional radio transmitters, and 1811 total elk observations. His findings indicated that a small portion of the wintering population remained on or near the winter-spring range all year; but the majority moved to summer-fall range west of Fish Creek as far as the Idaho Divide. Movements to summer range of the latter group varied from 6 to 11 miles and occurred during a two week period in early June. A few moved eastward into, or east of, Petty Creek. Calving occurred on winter range, or enroute to summer range, with no well-defined calving areas. Return to winter range occurred during a 3-4 week period in late November and December in response to increasing snow depths. Two elk used the same summer range each year while 3 used different ranges. All radioed elk returned to the same drainages each winter; some to the same feeding areas. Seasonal ranges were described using physical characteristics of 461 elk locations. Heavily timbered sites at higher elevations were used most during the fall while seral brush fields at lower elevations were used most during the winter. Hunting activity appeared to trigger sudden unusual movements of up to six miles by some elk and increased use of dense timber canopy. Elk locations averaged 1.7 miles from primary roads and 1.1 miles from secondary roads. These distances were somewhat closer to roads than would be expected from purely random distribution. Distance to water averaged 0.2 miles. Observations of elk near the Montana Creek road after it was closed by the Forest Service indicate that road closures may encourage elk to use previously logged areas.

LITERATURE CITED

Janson, Reuel G. 1975. Elk harvest, distribution & food habits, Montana Cooperative elk-logging study annual progress report, August, 1975. Department of Fish and Game, Helena. pp. 14-24.

Lemke, Thomas O. 1975. Movement and seasonal ranges of the Burdette Creek elk herd and an investigation of sport hunting. M. S. thesis, University of Montana, Missoula. 127 pp.

Submitted by: Reuel G. Janson

JOB II-B
Long Tom Creek Study
Progress Report for the Period
January 1, 1975-December 31, 1975

INTRODUCTION

The objectives of this study are to determine the environmental requirements of elk and the effects of logging on an elk population in the scattered forest type of Long Tom Creek in Southwestern Montana. Field work has been conducted from June-November each year, 1972-1975. Findings from the 1972-74 field seasons comprise the pre-logging data base. This field season (1975) marked the beginning of the logging activity in the study area with the cutting of 2 of the 14 cutting units and continuation of new road construction. Approximately 3.25 miles of road were cleared during summer and fall, 1975 (Fig. 1). Because of a suppressed timber market and road construction delays, it is likely that an extension of one year will have to be granted on the sale; this would mean timber cutting and removal would continue through the fall of 1977 and clean-up operations would be conducted during the summer and fall of 1978. The new road will be closed (with a gate) to motorized public access for at least the duration of the study.

Description of the Study Area

Long Tom Creek, located about 25 miles southwest of Butte, Montana, is a side drainage of Jerry Creek which flows southerly and empties into the Big Hole River near the village of Wise River (Fig. 2). Elevations range from 7,000 to 9,100 feet with the Continental Divide forming the north boundary of the study area. The Long Tom Creek-Upper Johnson Creek study area comprises about 36 square miles and is mostly timbered. A variety of timber and habitat types are represented, to include lodgepole pine, Douglas-fir, subalpine fir, whitebark pine, Engelmann spruce, and combinations thereof as dominant overstory species. The area is interspersed with numerous small, wet sedge meadows and bogs, parks, rocky ridges and open, south-facing sagebrush and grasscovered slopes. Clearcut logging has occurred in the head of Jerry Creek to the east and in lower Johnson Creek to the south and southwest. The only public vehicle access to the area is by 4-wheel drive from the east and northeast during periods of relatively dry road conditions. The study area is a portion of Hunting Unit 319 and is mostly on the Beaverhead National Forest with a small portion to the north located on Deerlodge National Forest land.

Methods

As during previous field seasons elk use of the study area was determined in 1975 primarily from "elk sign" recorded while periodically and systematically walking approximately 62 miles of foot routes. Because of

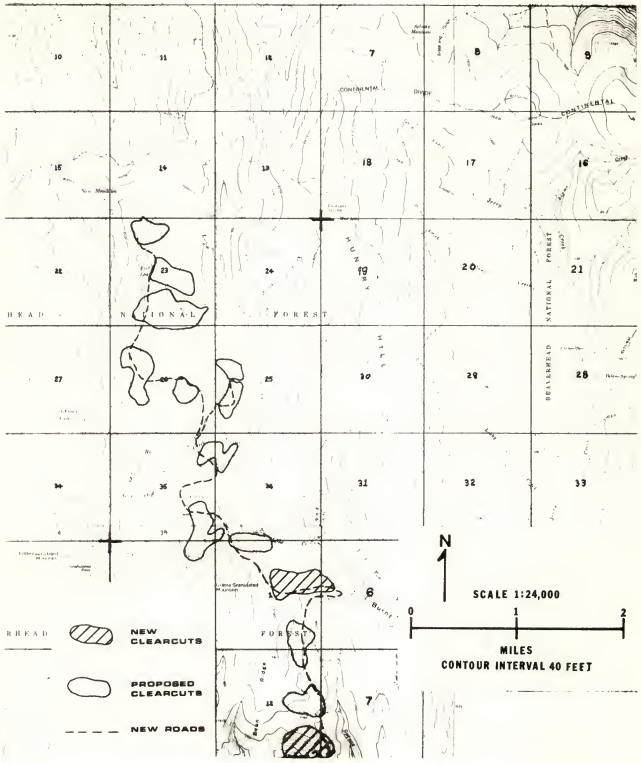


Figure 1. New and proposed clearcuts and main road construction.

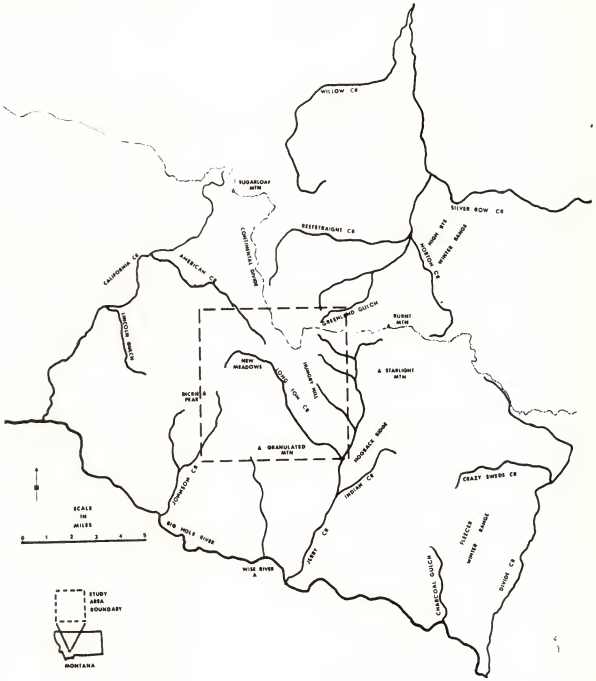


Figure 2. Vicinity of the Long Tom Creek Study area.

the late spring and early fall the 11 foot routes were only walked 4 times (July 3-Sept. 25). As in previous years the time interval between each "run" of the route system was about every 3 weeks. It took about one week for two men to walk and measure elk use along the route system. During 1972, each route was walked 4 times (August 1-November 9). In 1973, comparatively mild winter and spring weather conditions allowed us to begin walking routes on June 5, while comparatively severe weather conditions prevented any routes to be walked after October 31. In 1974, each route was walked 7 times starting on June 19 and ending on October 30.

The eleven foot routes were established in 1972 with minor revisions made in 1973. They range from approximately 3.0 to 9.0 miles in length and average 5.6 miles. Each route has been divided into segments with each segment representing a single general cover type; park, broken park, timber, or clearcut. For further detail and description of the segment classification system, see previous progress reports (Lonner, 1974 and 1975). Measurements recorded along the route system are presented in Table 1.

Elk use has been measured by two methods each time the route system was "run". Pellet groups along a transect were counted and classified into 4 age groups; last year (counted first run of route system only and were in the form of hard pellets from previous fall(s) use), this year (those droppings not in the recent or fresh category), recent (since segment was walked previous run), and fresh (less than 24 hours old). This measurement was then quantified into a common elk use factor of pellet groups/pace/segment/run or group of runs. Observer bias due to various observation distances between the different cover types was minimized by restricting the pellet count to a belt 6 feet wide. The other method of recording elk use was by assigning a general impression of elk use (GIEU) to each segment when it was surveyed. Four categories were used and each segment was assigned an elk use factor of either none, light, moderate, or heavy based on all elk sign observed in that segment (tracks, beds, pellet groups, elk, wallows, etc.). This measurement of elk use wasn't as quantitative as counting pellet groups, but it was more encompassing and did account for all elk sign detected. It most simply recorded elk use in each segment to be or not be there. These two elk use methods were used separately to describe elk use of the study area and will provide the opportunity to compare elk use between segments with various physiographic, morphologic and phenological characteristics and will also provide a relatively sensitive method of describing not only seasonal shifts in elk distribution, but yearly shifts as well.

The study area has been subdivided into 16 units to help define and describe elk distribution. These subdivisions were based on a combination of topographical and morphological features, and general homogeneity. Each of the 16 areas includes a portion of the foot route system (Fig. 3).

Radio telemetry was again used in an attempt to gather detailed information on elk movements and distribution in and between the study

Table 1. List of 28 measurements for each of the 700 segments composing the 62 mile foot route system in the Long Tom Creek study area.

Elk use (pellet groups and general impression)[1]
Deer use (pellet groups, observations, tracks)[1]
Cattle use (droppings per pace, observations, tracks)[1]
Forage use[1]
Wetness type[1]
Wetness degree[1]
Segment length[2]
Cover type[2]
Habitat type[2]
Dominant and sub-dominant tree species[3]
Average tree height[3]
Density of mature trees[3]
Density of regeneration[3]
dbh averages[3]
Canopy coverage[2]
Tree stand age[3]
Distance to closest cutting unit and/or road[4]
Sight distance[2]
Downfall[2]
Ground cover or understory vegetation (largely explained by habitat type)[2]
Aspect[2]
Configuration[2]
Topography[2]
Slope (%)[2]
Size of opening (park, broken park, clearcut) segment passes through (if applicable)[2]
Indices of interspersion, diversity, and homogeneity for each of the 4 general cover types and combinations thereof.[3] (generally explained in the 1973 progress report).

[1]Measured each time segment is surveyed (all others only measured once).
[2]Measurements are completed.
[3]Measurements are 60-70 percent complete
[4]Measurements not yet done.

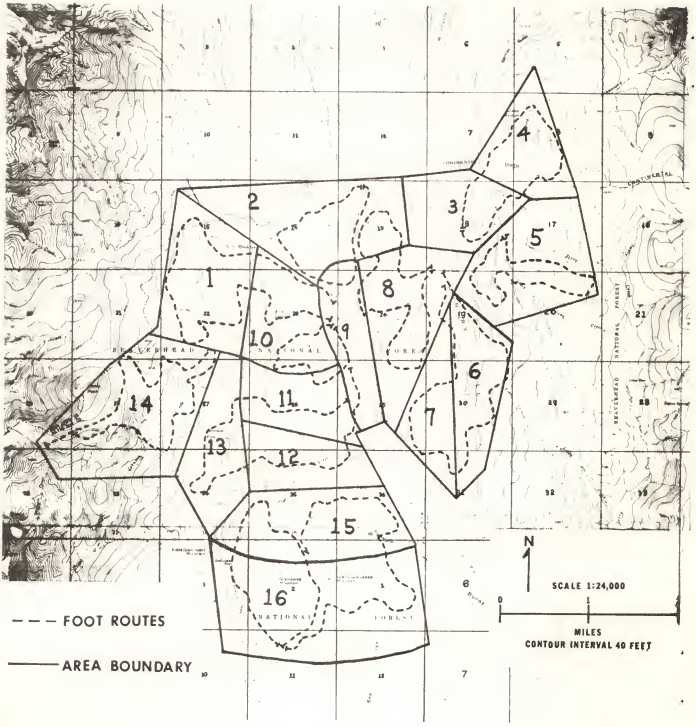


Figure 3. Subdivided areas and established foot routes.

area and the Fleecer-High Rye winter range areas. All transmitters were put on using a helicopter and capture gun. Eight cow elk were tracked on a weekly interval primarily by light plane during the summer and fall months, providing some very accurate and consistent information on their movements and distribution. The radioed elk were usually associated with several other elk, thereby giving us locations of more than just 8 individual elk.

Hunter questionnaires were filled out on opening day of the general big game season at 5 check stations located near the Long Tom Creek study area. Similar surveys were conducted in 1972, 1973 and 1974 and will be continued throughout the study.

Time lapse photography was again used in the study area and involved three 8 mm movie cameras during the 1975 field season. The cameras were rigged with new timing actuators that could trigger the camera (1 frame at a time) from 1 second to 256 minute intervals, in magnification powers of 2, with or without a photocell in the circuit. With the photocell employed the cameras did not take pictures at night. The cameras were used in 2 natural openings and a cut-through park within a large clearcut.

Permanent vegetation plots were established in 6 of the 14 proposed cutting units during the 1974 field season and the remaining 8 were completed in 1975. For information on this method see last year's progress report (Lonner, 1975). Elk use adjacent to the proposed logging road, and within and immediately adjacent to 13 of the 14 cutting units, was completed last field season. Elk use adjacent to the proposed road was measured by six foot wide belt transects established approximately every 1/4 mile and extending 200 yards (paces) on each side and perpendicular to the road. Elk use, both pellet group counts and general impression, was recorded for each of 4 consecutive 50 yard transects on both sides of the road. A diagrammatic explanation of how elk use was measured in and adjacent to the cutting units is presented in Figure 4.

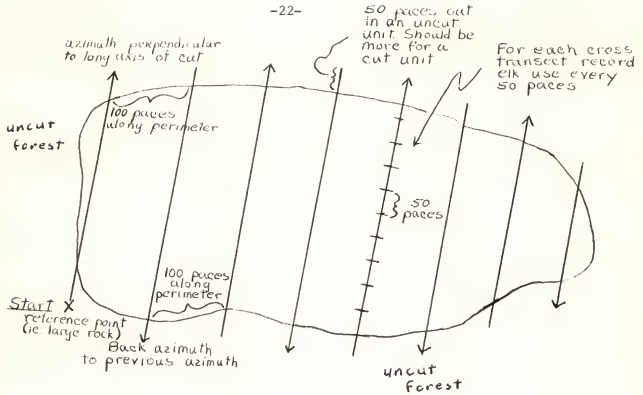

50 paces out in an uncut unit. Should be more for a cut unit
azimuth perpendicular to long axis of cut
For each cross transect record elk use every 50 paces
100 paces along perimeter
uncut forest
50 paces
100 paces along perimeter
Start X reference point (ie large rock)
Back azimuth to previous azimuth
uncut forest

Figure 4. A diagrammatic explanation of how elk use was measured in the proposed clearcut units.

FINDINGS AND DISCUSSION

Elk Distribution and Movements

The distribution of elk use within the study area for 1972-1975, as defined by the 16 subdivided areas for the 3 seasonal categories, was quite varied within and between areas, although there were some significant consistencies (Figs. 5-9).

Besides possible logging activity influences in 1974 and 1975 some of the contributing factors for variation of elk use within and between areas were: weather conditions and/or related phenological conditions of the forage; distribution of cattle; semi-nomadic behaviour of the elk; and annual fluctuation in natural and hunting mortality rates. These factors could mask the influences of logging activity. Our telemetry data indicate elk move considerably week to week and a summer

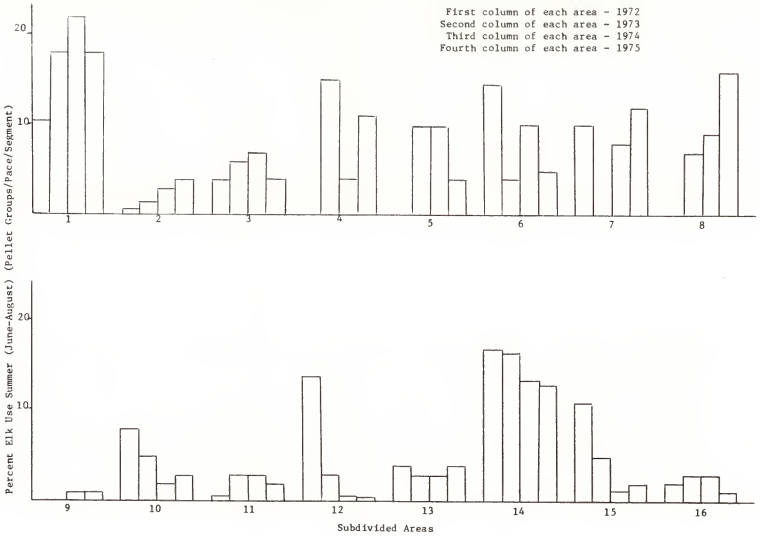


Figure 5. Distribution of elk use within the study area for the summer season (pellet group method).

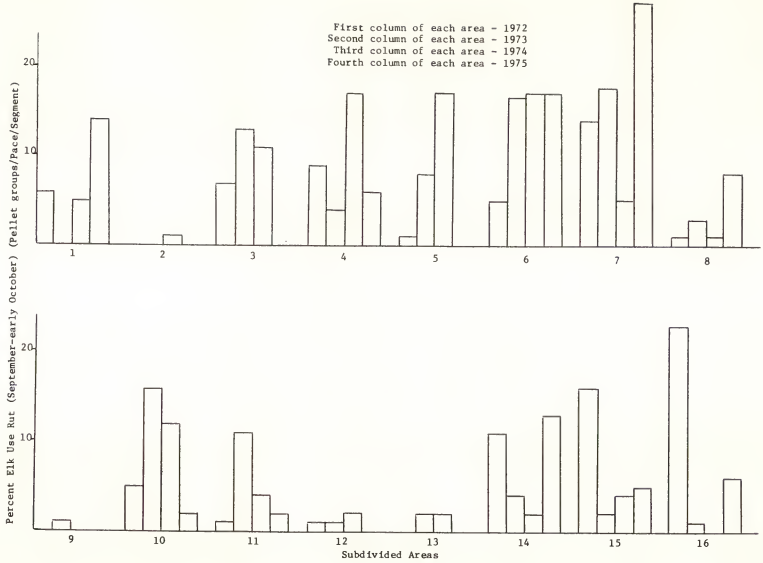


Figure 6. Distribution of elk use within the study area for the rutting period (pellet group method).

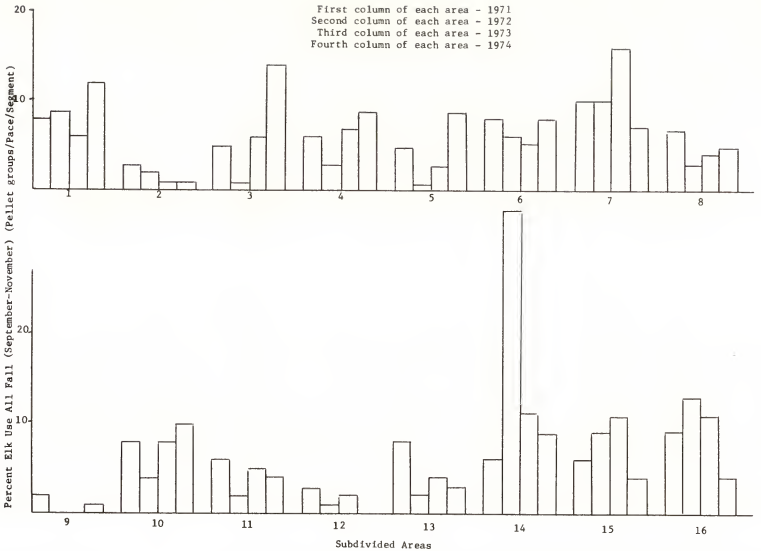


Figure 7. Distribution of elk use within the study area for the entire fall season (pellet group method).

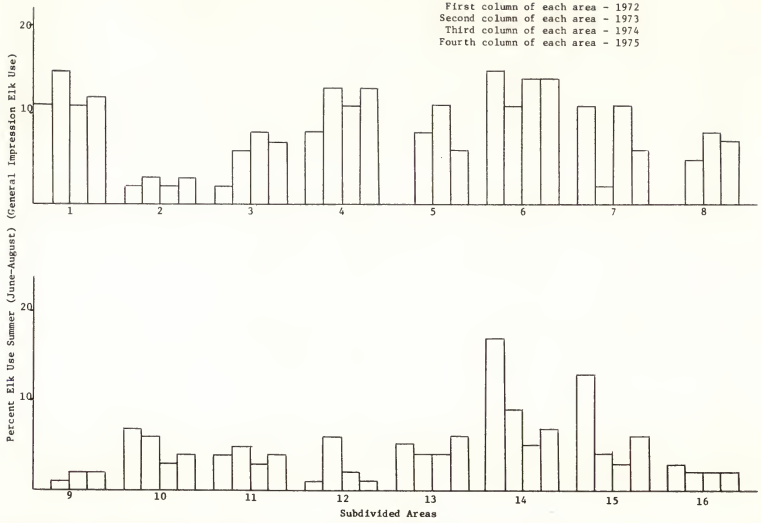


Figure 8. Distribution of elk use within the study area for the summer season (general impression method).

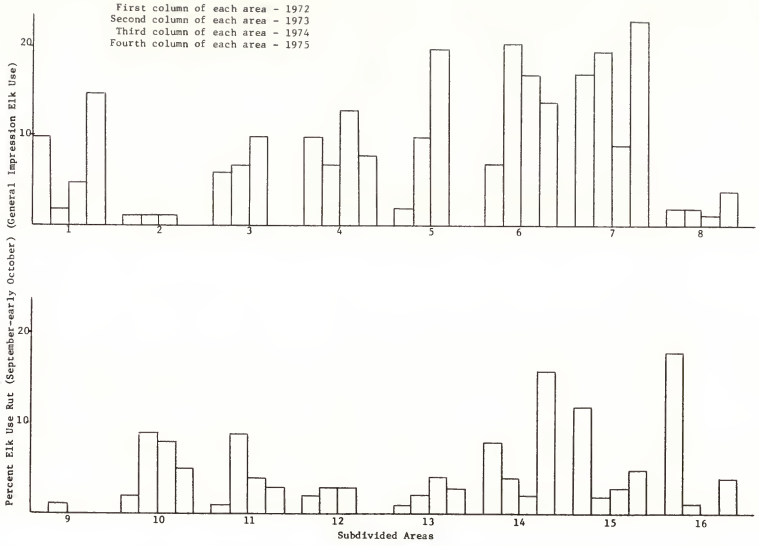


Figure 9. Distribution of elk use within the study area for the rutting period (general impression method).

range may occupy several square miles; some of the subdivided areas may have to have boundary revisions to compensate for these movements and reduce the influence of these and other masking effects.

During 1975 the overall summer and early fall (rut) elk use of the study area was the lowest it has been since field work began in 1972. For the entire fall months the overall elk use has consistently declined since 1971, through the fall of 1974 (Fig. 10). Fall use during 1975 will not be measured until the 1976 field season when pellet groups dropped during previous fall(s) will be recorded. The most apparent and largest contributing factor for the low elk use in the study area during the summer and early fall months in 1975 was weather conditions. Data from previous years show elk start using the fringes of the study area by mid-June and entirely by the end of June and that the elk use continues through October into November. Heavy and frequent snow storms during the spring of 1975 did not allow elk to start using the study area until mid-to late July and snowstorms in early October forced elk out of the area by mid-October. Consequently, the elk use of the study area was not only restricted to a comparatively short time period in 1975, but elk may have remained more dispersed throughout the area surrounding the study area because of the delayed and prolonged greenup of important forage species.

Since road construction was very active most of the summer and early fall in 1975, especially in the southern portion of the study area, this also could have contributed to the low elk use that year. Intense logging activity will have to take place in the study area before any definite influences on the spatial and temporal distribution of the elk can be conclusively detected.

Cattle use of the area did not appear much different in 1975 than in previous years and should not have been a major influence on any change in the overall elk use of the area.

Elk-Cattle Interaction

Cattle use of the area (reflected by dropping counts, forage use, and observations) has generally occurred between mid-July and mid-October.

As in 1973 and 1974 (Lonner, 1975), cattle use of the study area significantly influenced the distribution of elk during the summer and early fall months in 1975.

Figure 11 shows the proportions of the route system used by cattle, elk, both, or neither for runs 1 through 4 (approximately July 1 - Sept. 25) and for runs 2-4 combined. As cattle use of the route system became more extensive with the progression of the summer, elk use either remained the same or declined; that portion of the route system with simultaneous cattle and elk use did not exceed 3 percent for any particular run.

Coefficient of association values (Cox, 1970) were calculated based on data collected during runs 2 through 4. Data were not used for run 1

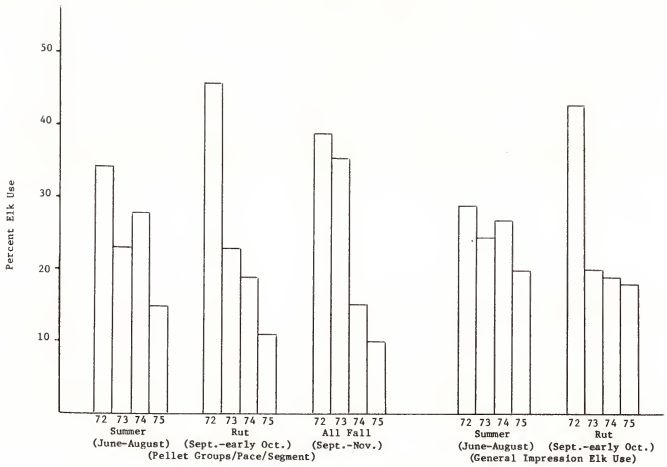
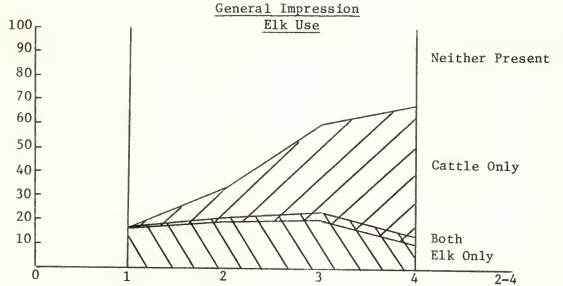
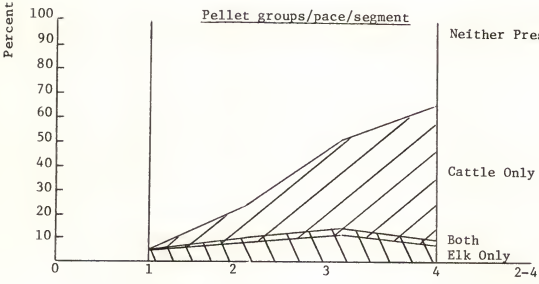


Figure 10. Year to year elk use intensity comparisons for the study area by season and elk use recording method.



N/A	-.77	-.65	-.65	-.69	Coefficient of Association
N/A	.0005	.0000	.0000	.0000	Chi-square P-value

Runs of route system with respective statistical values.



N/A	-.72	-.43	-.57	-.49	Coefficient of Association
N/A	.047	.0004	.0000	.0000	Chi-square P-value

Runs of route system with respective statistical values.

Figure 11. Proportion of route system used by elk and/or cattle for the 1975 field season.

since cattle are not usually in the study area that early in the summer. This coefficient could vary from +1.0 indicating a condition of maximum possible co-occurrence to -1.0 indicating a condition of minimum possible co-occurrence. Positive associations, or co-occurrence more frequently than expected by chance, may indicate existence of co-actions desirable to one or both species. Negative associations, or co-occurrence less frequently than expected by chance, may be indicative of co-actions undesirable to one or both species. A value of 0 indicates the frequency of co-occurrence expected by chance.

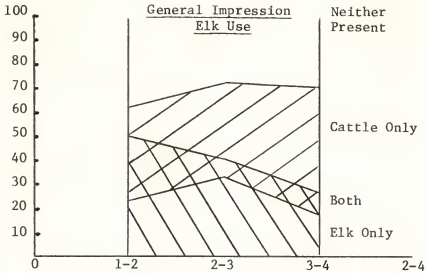
All coefficients of association were negative and ranged from -.43 to -.77. The average coefficient of association values for runs 2 through 4 for the pellet group method was -.49 and -.69 for the general impression elk use method. A 2x2 chi-square test was used to determine the significance level of the coefficients of association. The null hypothesis tested was: that the proportions of segments used by elk were the same for segments with and without cattle use. In all tests a highly significant P-value was calculated (Fig. 11), meaning the null hypothesis as stated above would have to be rejected. This means that the difference between the two proportions did not occur by chance or by sampling error and that the difference could be mostly attributed to a negative response of elk towards cattle in the study area.

Inter-run Comparisons

As in the 1975 progress report, another analysis approach was used to help determine if a true negative association or response of elk toward cattle existed or if the response detected by the above analysis was the result of elk and cattle preferring different environmental conditions and consequently using different areas. For runs 1 through 3, each segment with elk use was compared to the type of use recorded in that segment the following run about 3 weeks later (runs 2 through 4) - use at that time was recorded as elk, cattle, both or neither. Calculations did not include run 1, since cattle were just getting into the study area at that time. Both elk use methods were used in this evaluation.

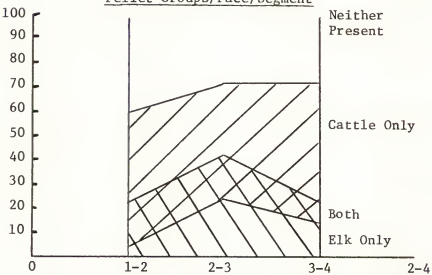
All coefficient of association values were negative and ranged from -.1 to -.49. The only association value that did not have a significant chi-square P-value was for the pellet group elk use method during run 2-3 (Fig. 12). This non-significance was probably due to the overlapping, but not simultaneous, use by elk and cattle as cattle were just moving into the study area. Since the route system was walked every 3 weeks, both elk and cattle use would have been recorded in some segments even though the elk use may have occurred early in the 3 week period with the cattle use occurring later.

In essence, this was the hypothesis tested: the probability of elk use occurring in the same segments during 2 consecutive "runs" of the route system was the same with or without cattle use. For runs 2-4 combined in 1975 these probabilities were .12 for those segments with cattle use and .18 for those without cattle use for the pellet group elk use



N/A[1]	-.49	-.39	-.45	Coefficient of Association
N/A	.0006	.003	.0000	Chi-square P-value

Percent



N/A	-.1	-.32	-.24	Coefficient of Association
N/A	.73	.075	.047	Chi-square P-value

Runs of route system with respecitve statistical values.

[1] Calculation of the chi-square value was not made when the expected value for any cell of 2x2 contingency table was less than 5.

Figure 12. Proportion of route system used by elk and/or cattle for segments where elk sign was present the first of any 2 consecutive runs for the 1975 field season.

method. These probabilities were .08 and .25 respectively, for the general impression elk use method. For 1974 and 1973 runs 2-5 were combined. In 1974 these figures were .05, .22, .05, and .32, respectively and in 1973 they were .06, .20, .06 and .34 respectively. In all cases the probability of finding elk use in the same segments after 2 consecutive runs of the route system was higher without cattle use compared to those with cattle use. All differences in probabilities were statistically significant at $P \leq .15$.

Forage Use

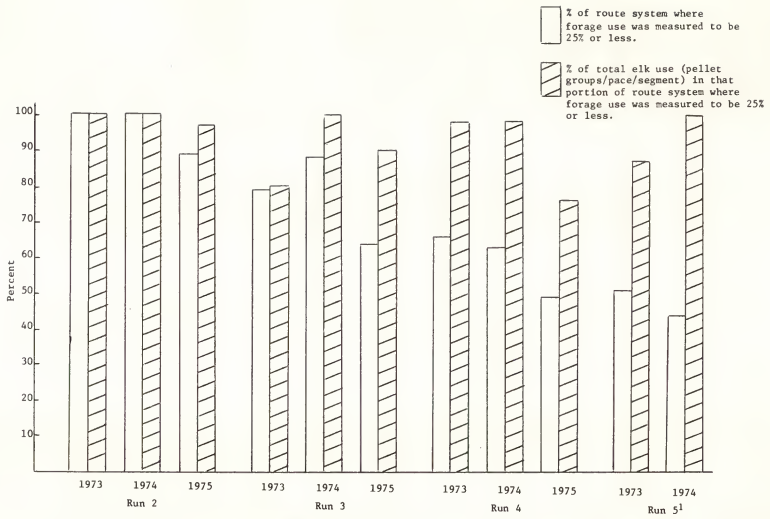
No less than 75 percent (average 93%) of the total elk use recorded during the summer and early fall in those segments where forage use was measured (park, broken park, clearcut), occurred in that portion of the route system where forage use was measured to be 25 percent or less (Fig. 13). Most of the segments where forage use was over 25 percent were used by cattle. Forage use in those segments where only elk use was recorded did not exceed 25 percent.

These data suggest that not only was there a negative response of elk towards the presence of cattle, but also a strong aversion by the elk toward those segments used by cattle even after the cattle had left the immediate vicinity of these segments. While these data indicate some degree of forage competition may exist between elk and cattle in the study area during the summer and early fall months, the biological effects on the elk have not been determined. Since cattle grazing has occurred in the study area for many years and the elk herd does appear healthy and productive, such effects may be academic. However, other increasing human based activities (logging, mining, recreation, etc.), in combination with the cattle grazing in the area, may have a synergistic effect on the elk population that could be very detrimental.

Telemetry

Of the 11 elk radio-collared during the spring in 1974, only 3 were working well enough to track during most or all of the 1975 field season. One of these (Channel 4) was poached on October 31, 1975 and Channel 10 has not been located since October 3, 1975. Channel 2 was still working well going into the 1976 field season. During the spring of 1975, seven more cow elk were radio-collared; 4 on the High Rye Winter Game Range and 3 on the Fleecer Winter Game Range. All of these transmitters, except Channel 12, were working well going into the 1976 field season. Channel 12 has not been located or seen since October 24, 1975. The interval between relocations for most of these elk was approximately 7 - 10 days for the spring, summer, and fall seasons and about 3 - 4 weeks for the winter months. Most relocations were made from a light plane. A summary of general information and seasonal movement statistics for these radioed elk is presented in Table 2.

A computer program was written and is being used to keep a running account of telemetry information. For each date an observation is made, information for each radio-collared elk such as description of location



[1]Only 4 runs of route system were made in 1975.

Figure 13. Percent of total elk use found in segments with recorded forage use of 25 percent or less.

Table 2. General statistics on 10 cow elk that were radio-equipped and tracked from 1 May 1975 to 30 April 1976.

Radioed Elk Ch[1] No.	Sex	Age[2]	Winter Range where Captured	Locations and Distances (Aerial Miles) Season and Yearlong Relocations																								Max. Distance Between Any 2 Locations
				Spring May 1 - June 15				Summer June 16-Aug. 31				Rut Sept. 1-Oct. 15				Hunting Oct. 16-Dec. 5				Winter Dec. 6-Apr. 30				Yearlong May 1-Apr. 30, 1975 1976				
				No.[3]	$\bar{X}$[4]	Area[5]	Max[6]	No.	$\bar{X}$	Area	Max	No.	$\bar{X}$	Area	Max	No.	$\bar{X}$	Area	Max	No.	$\bar{X}$	Area	Max	No.	$\bar{X}$	Area	Max	
175	F	5½	High-Bye	5	2.2	8.5	4.5	7	3.1	22.6	4.9	7	1.9	5.6	3.9	4	2.3	3.0	2.7	4	1.9	1.7	2.7	28	2.8	63.6	9.1	14
274[8]	F	Ad	Fleecer	5	2.9	10.1	5.2	7	.7	.9	1.0	-	-	-	-	-	-	-	-	-	-	-	-	19	1.5	28.1	5.2	11.2
274	F	Ad	Fleecer	5	2.9	11.8	5.9	14	1.5	8.1	3.0	9	2.5	11.6	4.4	4	1.4	1.5	2.1	5	1.0	.8	1.3	37	2.0	35.1	5.9	11.3
474	F	Ad	Fleecer	-	-	-	-	4	.6	.03	.9	5	.6	.5	1.0	Killed on 10/31/75				-	-	-	-	11	2.6	32.6	16.3	19
575	F	Ad	High-Bye	4	.8	.6	1.1	7	2.4	13.4	5.7	9	1.0	4.2	4.1	4	3.9	6.5	5.1	6	2.1	3.6	3.7	31	2.5	52.7	10.0	16.2
675	F	1½	Fleecer	5	1.9	.7	3.5	9	2.0	6.9	3.9	9	.8	1.5	1.1	4	3.5	5.9	5.7	5	1.1	1.1	1.8	32	2.0	22.0	7.3	8.8
875	F	Ad	High-Bye	6	.3	0[9]	1.6	9	2.0	11.4	5.1	9	.9	2.7	2.4	4	1.4	.3	2.5	6	1.5	4.6	2.5	35	1.4	27.5	5.6	8.5
975	F	1½	High-Bye	5	1.8	2.6	2.7	10	2.1	7.6	3.5	9	1.5	5.1	3.0	4	.5	.1	.7	6	1.6	5.4	2.5	35	2.0	31.1	8.1	12
1074	F	Ad	High-Bye	-	-	-	-	4	3.0	2.6	5.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1175	F	Ad	Fleecer	5	1.6	1.3	3.6	13	1.8	10.4	3.5	9	2.1	7.3	4.7	4	4.3	.2	5.5	6	1.3	1.8	2.5	38	2.3	30.7	7.5	11.5
1275	F	Calf	Fleecer	3	1.8	.6	2.0	9	1.7	3.7	4.1	9	1.1	5.5	3.2	Last located on 10/24/75				-	-	-	-	21	1.4	21.2	4.1	7
Totals and Overall Averages				43	1.8	4.0	3.3	93	1.8	8.0	3.7	75	1.4	4.9	3.1	28	2.7	2.5	3.5	38	1.5	2.7	2.4	287	2.0	34.5	7.9	12.0

[1]First digit is channel number and other 2 are the year collared.
[2]Age at capture.
[3]Number of relocations.
[4]Average distance moved between successive locations.
[5]Area in square miles based on connecting perimeter locations to form a polygon.
[6]Maximum distance moved between two successive locations.
[7]Data insufficient for calculation (none or less than 3 locations).
[8]These data for spring, 1974 through winter 1975.
[9]Relocations involved only 2 points on the map.

(legal and general), habitat type, group size and composition, elevation, etc. is input into this running file stored by the computer. The program was designed for terminal use and has 4 main options: update the file, correct any portion of the file, retrieve any or all data in the file, and make area and movement calculations for any channel or series of channels between any two given dates.

The average distance moved between any 2 successive relocations ranged from 0.3 (by Channel 8 during the spring season) to 4.3 miles (by Channel 11 during the hunting season) and the maximum distance moved between any 2 locations for any particular elk was 19 air miles. Seasonal home ranges were quite varied ranging from near 0 to 22.6 square miles with a yearlong overall average of about 1 township (34.5 square miles) (Table 2).

For Channel 2 during the summer season in 1974, the range area was 0.9 square miles while for this same season in 1975 the range area was 8.1 square miles. The unusual wet and cold weather during the summer in 1975 may have been responsible for this large increase in area. On August 25, 1975, following an intensive 4 day storm, this elk was found toward the winter range and approximately 2½ air miles east of the previous location which was on August 18, 1975. This August 25 location was approximately 5 miles SE of the 1974 summer geographic activity center (weighted mean of all relocations). These two relocations would largely account for this increase in summer home range during the 1975 summer.

Standard diameters for 8 of these elk are compared in Figures 14 and 15 for the summer and rutting season, respectively, and in Figure 16 for 7 radio-equipped elk during the hunting season. There was considerable variation in standard diameters between the elk within and between these seasons. A further illustration of variation between seasonal ranges is presented in Figures 17-20. Included on these figures are the polygon shaped yearlong (May 1, 1975 - April 30, 1976) ranges of these elk. The polygon figures were determined by connecting the outermost relocations, thus giving the best known representation of the range shape containing all of the relocations. Since these polygons only give reference to the animal's movements as related to space, seasonal standard diameters were calculated to give reference to movements related to both space and time. The standard diameters were calculated by using Harrison's (1958) formula:

$$SD = \sqrt{\Sigma D^2 / N}$$

where:

D is twice the distance from the geographic activity to each relocation, and

N is the total number of relocations.

The standard diameter describes the diameter of a circle which has the geographic activity center as its center with presumably at least 68.26 percent of the animal's activity occurring in that circle (Knight, 1970).

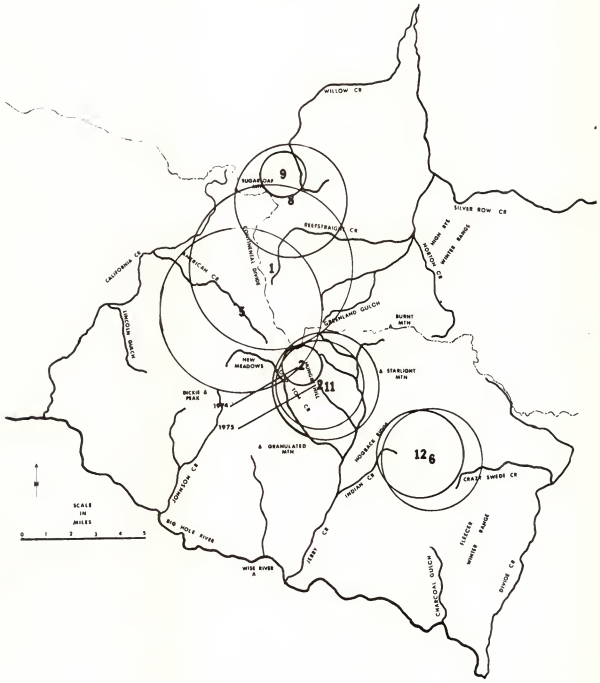


Figure 14. Standard diameters for 7 radio-equipped cow elk for the summer season (June 16-August 31) in 1975 and for 1 radio-equipped cow elk for the summer season in 1974 and 1975.

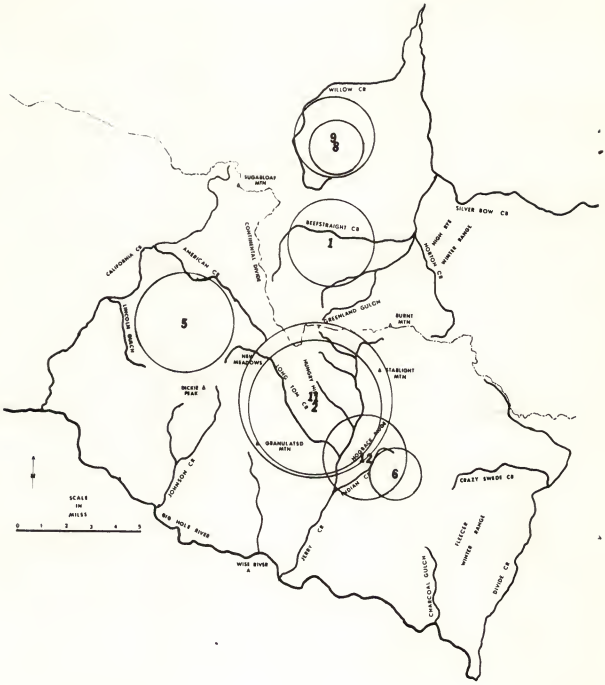
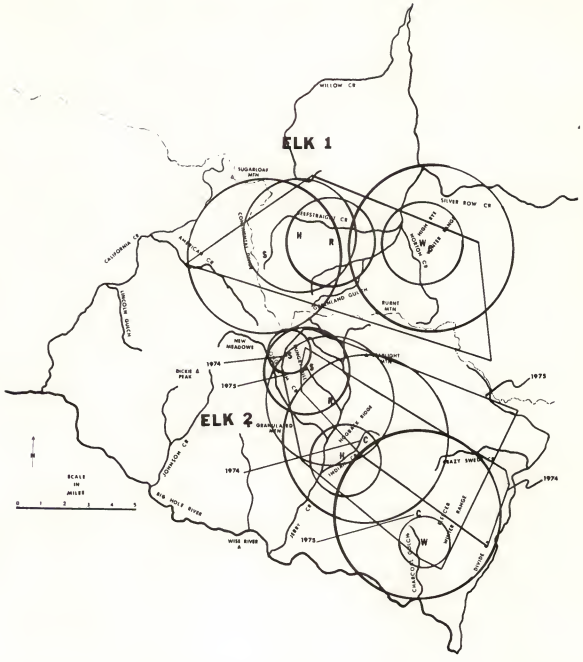


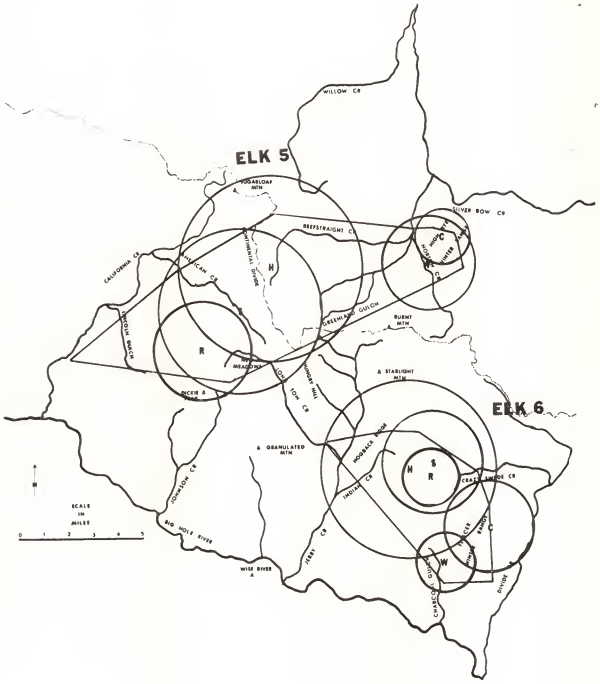
Figure 15. Standard diameters for 8 radio-equipped cow elk for the rutting period (September 1-October 15) in 1975.

Figure 16. Standard diameters for 7 radio-equipped cow elk for the hunting season (October 16-December 5) in 1975.



C=calving (May 1-June 15), S=summer (June 16-August 31), R=rutting (September 1-October 15), H=hunting (October 16-December 5), W=winter (December 6-April 30)
See Table 2 for number of locations used to calculate standard diameters.

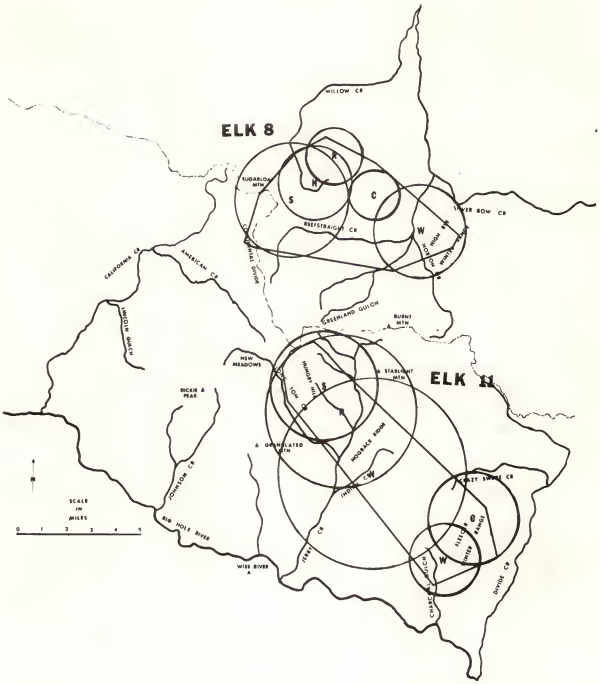
Figure 17. Seasonal standard diameters and yearlong polygons for elk 1 in 1975 and for elk 2 in 1974 and 1975.



C=calving (May 1-June 15), S=summer (June 16-August 31), R=rutting (September 1-October 15), H=hunting (October 16-December 5), W=winter (December 6-April 30)

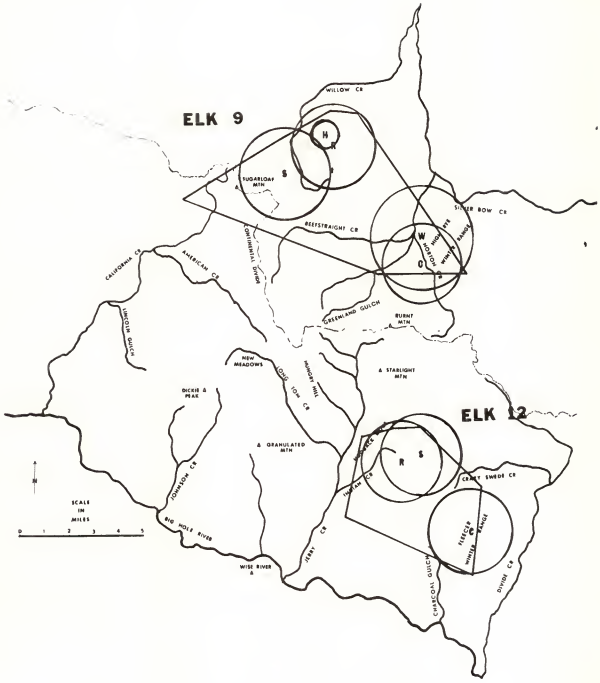
See Table 2 for number of locations used to calculate standard diameters.

Figure 18. Seasonal standard diameters and yearlong polygons for elk 5 and 6 in 1975.



C=calving (May 1-June 15), S=summer (June 16-August 31), R=rutting (September 1-October 15), H=hunting (October 16-December 5), W=winter (December 6-April 30)
See Table 2 for number of locations used to calculate standard diameters.

Figure 19. Seasonal standard diameters and yearlong polygons for elk 8 and 11 in 1975.



C=calving (May 1-June 15), S=summer (June 16-August 31), R=rutting (September 1-October 15), H=hunting (October 16-December 5), W=winter (December 6-April 30) See Table 2 for number of locations used to calculate standard diameters.

Figure 20. Seasonal standard diameters and yearlong polygons for elk 9 and 12 in 1975.

Although most of these data are based upon the movements of only 8 radio-collared elk, it does illustrate how dynamic and extensive elk movements can be. These data also point out why a well defined seasonal description of elk distribution within the relatively small 36 square mile study area may be difficult since there is constant ingress and egress of elk.

Elk Use-Habitat Type - Cover Type Relationship

In 1975 elk use-habitat type relationships were similar to previous years' findings, except the affinity for the wet sedge broken park type did not appear as strong during the summer months as in previous years. This was most likely due to the comparatively short and wet summer in 1975, which caused a widespread abundance and a possible longer duration of the more succulent and preferred forage species. Since the year to year variation of seasonal elk use between the various habitat types and general cover types has been similar (Lonner, 1975), data were pooled and a summation of elk use-habitat type relationships was made for 1972 through 1975 (Fig. 21). This also increased replication of surveys over the route system. The timber general cover type was subdivided into 13 forest habitat types after Pfister, et al., 1975 and an initial breakdown of the park, broken park, and clearcut general cover types was made based on the general vegetative and morphologic composition found in each type.

The preliminary findings on elk habitat use relationships were based on statistically comparing the average use that occurred in each type during a particular season with the overall mean elk use of the route system for that season. Positive associations, or means significantly higher than the overall mean, may indicate a preference or a concentration of elk use in a said type. Negative associations, or means significantly lower than the overall mean, may indicate an aversion or low concentration of elk use. Types listed as nonsignificant were those where elk use did not significantly deviate from the overall mean elk use. These aversion and nonsignificant types are not necessarily unimportant to elk, they simply are not areas of concentrated use. It is important to note the omnipresence of elk use throughout the various habitat and cover types as illustrated in Figure 21. These data also point out the difficulty in evaluating the importance between individual habitat and cover types and the overall interrelationship of these types with one another, not to mention interrelationships with extrinsic factors such as grazing, logging, hunting, etc.

Seasonal Variation of Elk Use Within and Between Habitat Types

SUMMER

During the summer months elk had a strong affinity for wet sedge parks and broken parks that were interspersed with and/or immediately bordered by the Alpine fir/*Calamagrostis canadensis* forest habitat type. Average sizes of these areas were 2.1 and 1.2 acres, respectively.

Ground cover composition was largely made up of Carex, spp. (*C. Scopulorum, C. Microptera, C. luzulina, C. Illota, C. aqualatic, C. rostrata,* and Carex spp. Ovales group), *Senecio triangularis, Senecio intergerimis, Arnica mollis, Phleum alpinum, Deschampsia Caespitosa, Veratrum viride,* and *Calamagrostis canadensis.* The dry park type with grasses and forbs showed significant use by the pellet group method, although most of this use occurred early in the season when these areas were the first to green up. The only forest habitat type that showed significant (GIEU method only) use by elk during summer was the Alpine fir/*Luzula hitchcockii-Vaccinium scoparium* type, which is also characterized by seepage areas. Elk use of the clearcut cover type in general was significantly higher than the overall mean. Much of this use occurred in and immediately surrounding natural dry and mesic parks which had been cut-through.

A significant negative association was recorded for the dry broken park general cover type. This was also true for the timber cover type with 7 of the 13 forest habitat types contributing to this low use (Fig. 21).

Rut -(September - early October)

A dramatic shift of elk use from wet sedge parks and broken parks during the summer to the timber general cover type and dry parks during the rut was very apparent all 4 years. Dry parks showing a significant increase in elk use were those with *Agrophyron spicatum* and/or *Festuca idahoensis* as the dominant grass and those that were often rocky and calareous with grasses and forbs as the dominant vegetation. Elk use of the timber general cover type was significantly above average in 3 of the 13 forest habitat types and above average in 7 of them. This compares with 3 above average during the summer months, of which only 1 was statistically significant. The clearcut general cover type, as during the summer months, received above average elk use. As in summer, the dry and mesic cut-through parks accounted for most of this use.

Fall (September-November)

Elk use of habitat and cover types during the fall was similar to elk use during the rut. Although the dry park general cover types were still important during the fall, a difference in subtypes occurred. Dry parks with shrubs, grasses, and forbs and dry parks with grasses and forbs were important subtypes during the fall. There was a general aversion of all broken park types during the entire fall season. The only statistically significant elk use of specific timber habitat types during this time was of the alpine fir (White-bark pine)/vasc type; however, a total of 4 types were above the overall average and none showed significantly low elk use. No significant use (positive or negative) of the clearcut types occurred.

Intra-Habitat Type Variation of Elk Use Within and Between Seasons

A substantial difference of elk use within 5 forest habitat types within seasons and between seasons occurred in the study area for 1972-1975.

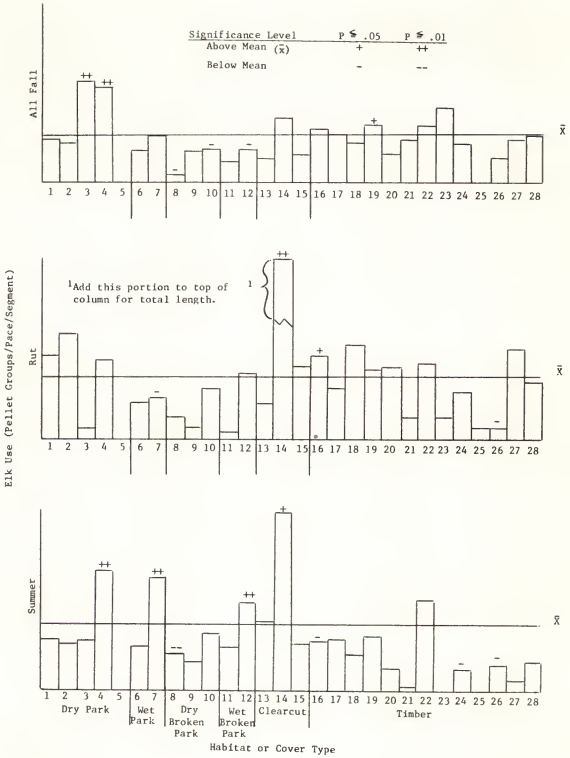
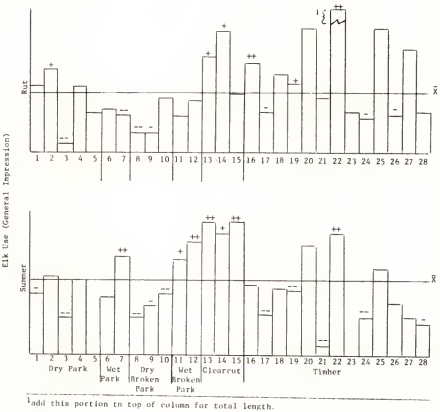


Figure 21. Seasonal elk use - habitat and cover type relationships for 1972-1975.


Elk Use (General Impression)
Rut
Summer
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
Dry Park
Wet Park
Dry Broken Park
Wet Broken Park
Clearcut
Timber

[1]add this portion tn top of column for total length.

Key to Habitat or Cover Types

1 - Dry Park with *Festuca idahoensis* and/or *Agropyron spicatum* dominant

2 - Dry Park rocky and calcerous-mainly grasses and forbs present

3 - Dry Park - grasses, forbs, and shrubs present

4 - Dry Park - grasses and forbs present

5 - Dry Park - talus or rockslide

6 - Wet or mesic park

7 - Wet sedge park with AF/caca interspersed and/or immediately hordering

8 - Dry Broken Park rocky and calcerous-mainly grasses and forbs present

9 - Dry Broken Park - grasses, forbs, and shrubs present

10 - Dry Broken Park - grasses and forbs present

11 - Wet or mesic broken park

12 - Wet sedge broken park with AF/caca interspersed and/or immediately hordering

13 - Clearcut - cut through timber

14 - Dry Park - cut through within a clearcut

15 - Wet nr mesic park - cut through within a clearcut

16 - *AF/*Vaccinium scoparium-Vaccinium scoparium* phase

17 - AF/*Vaccinium scoparium-Thalictrum occidentale* phase

18 - AF/*Vaccinium scoparium-Thalictrum occidentale* with AF/caca interspersed

19 - AF/(*Pinus albicaulis*)/*Vaccinium scoparium* phase

20 - AF/*Vaccinium scoparium-Calamagrostis rubescens* phase

21 - AF/*Calamagrostis rubescens*

22 - AF/*Juncus hitchcockii-Vaccinium scoparium* phase

23 - AF/*Menziesia ferruginea*

24 - AF/*Calamagrostis canadensis* (often only a stringer)

25 - AF/*Xerophyllum tenax-Vaccinium scoparium* phase

26 - *Pinus albicaulis*

27 - *Pseudotsuga menziesii/Juniperus communis*

28 - *Pseudotsuga menziesii/Calamagrostis rubens*

*AF = *Abies lasiocarpa*.

Figure 21. Continued.

These 5 habitat types were all within the *Abies lasiocarpa* (alpine fir = AF) series and were the AF/*Vaccinium scoparium-Vaccinium scoparium* phase, AF/*Vaccinium scoparium-Thalictrum occidentale* phase, AF/*Vaccinium scoparium Thalictrum occidentale* phase with the AF/*Calamagrostis canadensis* type interspersed within it, AF *(Pinus albicaulis)/Vaccinium scoparium* phase, and the AF/*Luzula hitchcockii-Vaccinium scoparium* phase. These 5 types comprise approximately 80 percent of the timber portion of the route system where timber density measurements have been taken; one third of the timber segments have not yet been measured for timber densities and will be completed during the 1976 field season.

Intensity of elk use was compared to 5 density classes of tree regeneration within each type for the summer season (June-August), the rut (September-early October), and the entire fall (September-November). Most of the regeneration was alpine fir. It was assumed that these 5 density classes provided an index of cover quality (or a relatively advanced successional stage), i.e., class 1 = least cover early successional stage .....class 5 = most cover late successional stage. Regeneration was considered to be all tree saplings and seedlings with a dbh of less than 4" and with a height of less than 20 feet. Seedlings less than 1 foot tall were not tallied.

During the summer months all 3 years, findings indicate very little selection for any particular density class. Conversely, during the rut and especially during the entire fall, elk use tended to increase as regeneration density increased (Figs. 22-24). This relationship was even more obvious when elk use between the 5 regeneration density classes was compared for each year and all years combined with habitat types disregarded (Figs. 25-27).

A thorough sample of elk use (based upon counts of fall pellet groups) within 11 proposed clearcut units showed elk use to intensify as the timber stands became older. These units ranged from 17 to 106 acres and averaged 44 acres. Each unit was habitat typed and approximate stand age was determined. Two habitat types were identified: *Abies lasiocarpa/Vaccinium scoparium* phase and *Abies lasiocarpa/Thalictrum occidentale* phase. Stand ages ranged from 115 to 225 years. Younger stands within these types were dominated by lodgepole pine with very little regeneration and a relatively clean understory. Older stands were dominated by alpine fir, Engelmann spruce and lodgepole pine with dense regeneration of alpine fir combined with a moderate to high degree of dead and down. There was a significant (P = .05) positive correlation (0.67) between intensity of elk use and stand age (Fig. 28). Although sample size was limited it does demonstrate the importance of relatively advanced successional timber stands (security cover) on elk fall range.

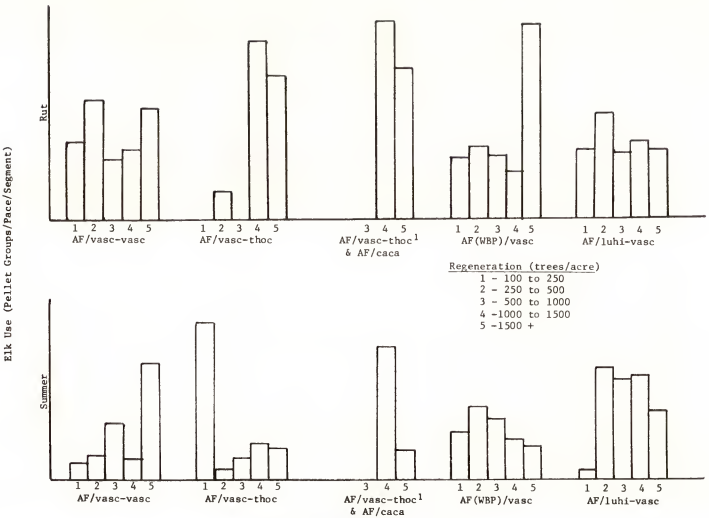


Figure 22. Elk use-cover type relationships within and between 5 forest habitat types based on 5 tree regeneration density classes for the summer and rutting seasons in 1972-1975 (pellet group method).

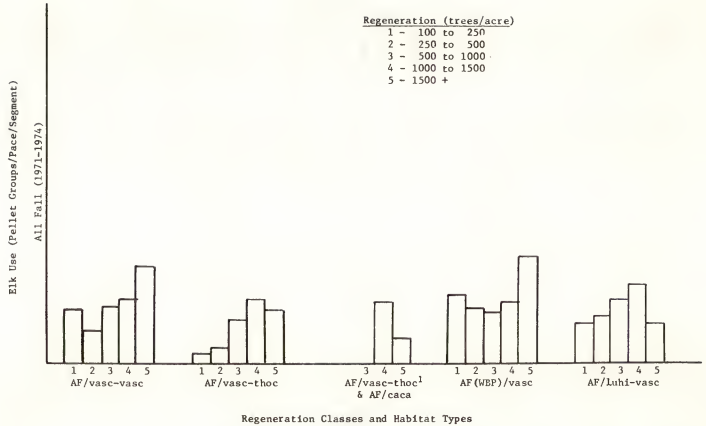


Figure 23. Elk use-cover type relationships within and between 5 forest habitat types based on 5 tree regeneration density classes for the fall season in 1971-1974 (pellet group method).

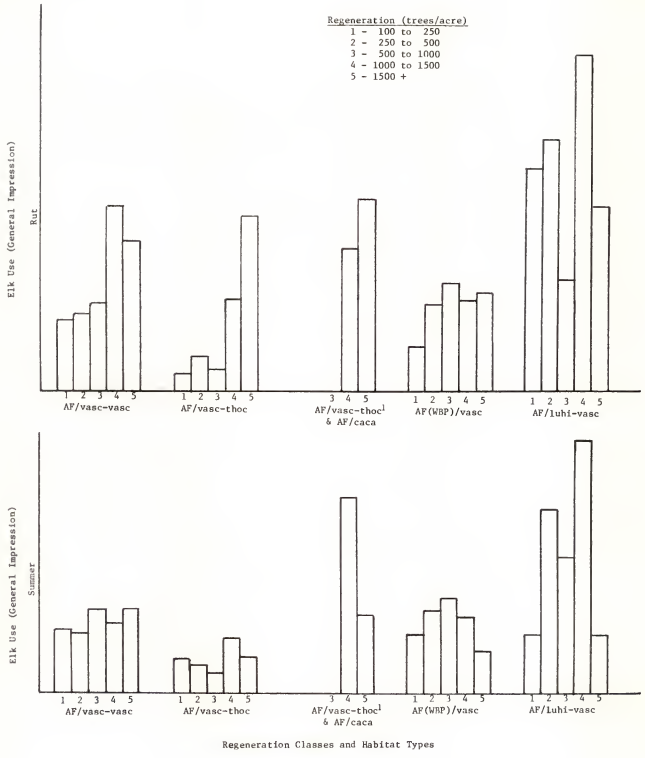


Figure 24. Elk use-cover type relationships within and between 5 forest habitat types based on 5 tree regeneration density classes for the summer and rutting seasons in 1972-1975 (general impression method).

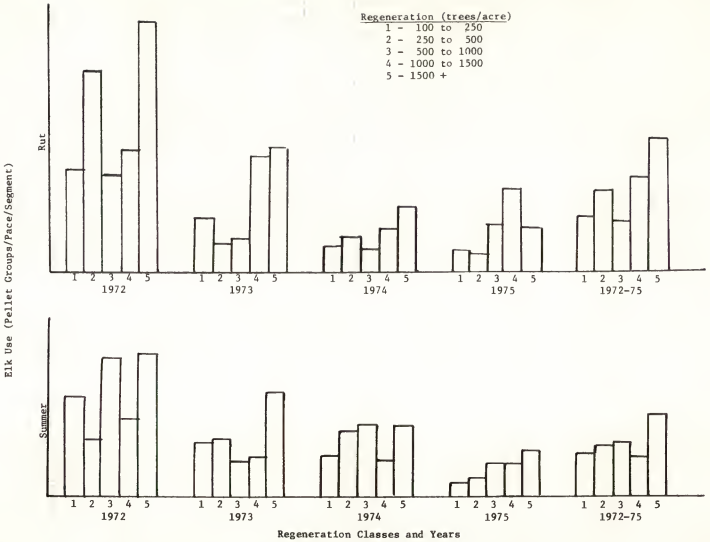


Figure 25. Elk use-cover type relationships within and between 4 years based on 5 tree regeneration density classes for the summer and rutting seasons (pellet group method).

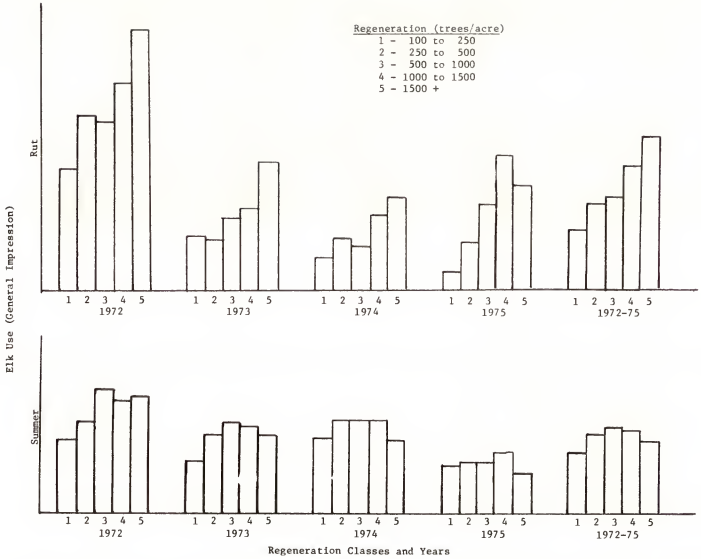


Figure 26. Elk use-cover type relationships within and between 4 years based on 5 tree regeneration density classes for the summer and rutting seasons (general impression method).

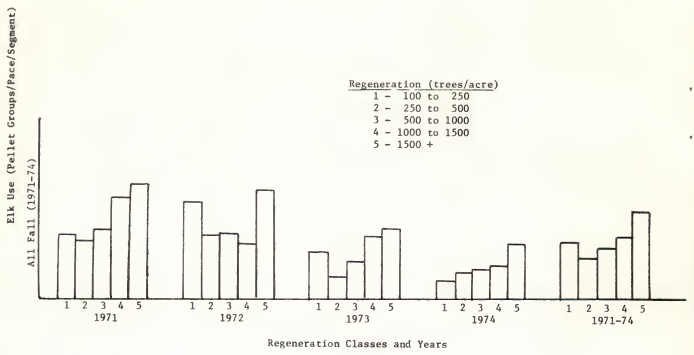


Figure 27. Elk use-cover type relationships within and between 4 years based on 5 tree regeneration density classes for the entire fall season (pellet group method).

These findings point out that while habitat type notations often give a reasonable description of plant community composition and ecological potential, the structural characteristics (cover types) of plant communities at a given time and general location can vary within habitat types and phases. Also, seral stages in different habitat types may be structurally similar. Elk use of these cover types within and between forest habitat types is often specific on summer and fall range. This can change in both space and time, i.e. moist sites within various habitat types may be highly preferred by elk from June through August with lower use during the fall months; relatively mature dense stands of timber may not be as important to elk during June through August as in the fall months. Awareness and knowledge of spatial and temporal differences of elk use within and between habitat types and cover types is of utmost importance before the full value of these types to the elk and timber manager can be realized.

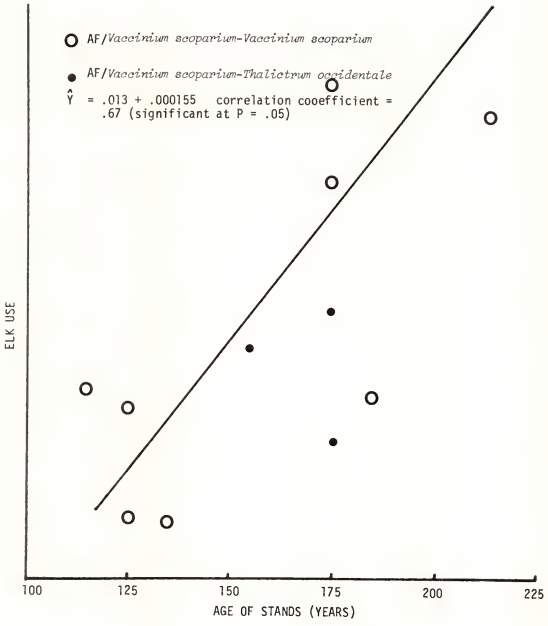


Figure 28. Comparison of elk use (pellet groups/pace) to stand age for 2 forest habitat types for the fall season in 1973 and 1974.

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Submitted by: Terry N. Lonner

JOB II-C

SAPPHIRE DIVIDE STUDY

Progress Report for the period
January 1-December 31, 1975

This segment of this report was not available at press time.

JOB II-D

CHAMBERLAIN CREEK STUDY

Progress Report for the Period January 1 - December 31, 1975

INTRODUCTION

A contract was awarded to the School of Forestry, University of Montana in 1975 by the Bureau of Land Management to continue the Chamberlain Creek Elk Study. Generally, the major objective of the study will remain the same - to determine the effects of several timber management practices on elk use as related to various available environmental factors within a previously undisturbed portion of Chamberlain Creek. However, there will be some changes in investigational techniques.

The timber management plan for National Resource Lands within the area has been completed by BLM personnel, and much prelogging data concerning elk use in Chamberlain Creek has been collected. These results were reported by Ellison (1975) in last year's progress report. The Burlington Northern Company is cooperating with the BLM, and will draw up the logging plan for the remainder of the study area, which is under their ownership. Timber harvest is not expected to begin prior to the fall of 1977, and probably not until the spring of 1978. Therefore, two additional years of pretreatment information will be obtained.

Because of inadvertent delays encountered during the summer of 1975 in the transfer of responsibility for the study, little field work was accomplished last year.

METHODS

At the suggestion of Dick Ellison, who completed earlier work on the Chamberlain study area, contour pellet transects were discarded. Instead, permanent belt transects, four feet wide, were established on a diagonal across the study area at 1/2 mile intervals. Similar transects will be added during the summer of 1976 to achieve intervals of 1/4 mile. During 1975, transects were broken into segments by habitat type (Pfister et al. 1974), and pellets were categorized as old or new. These data were treated by comparing the percentage of each habitat type encountered along the transects with the percentage elk use (as defined by pellet groups) in that habitat type. Pellet transect data were also used to describe elk distribution in the study area.

In addition to surveys of pellet transects, ground and aerial locations of radio-collared animals will be used to study elk distribution, movements, and some aspects of habitat use. Two corral traps were erected on adjacent winter ranges, and seven elk (all cows) have been radioed. If we are successful in marking several animals which spend a major portion of their time within the core study area on the summer-fall range, greater emphasis will be placed on this data collecting method.

A comprehensive study plan is being prepared, and will be included in next year's progress report. Generally, techniques will be similar to those being used in other investigations of the Montana Cooperative Elk-Logging Study (Lyon 1973 and 1974, and Lonner 1975) in order to facilitate comparison of results.

FINDINGS AND DISCUSSION

Table 1 shows elk use by habitat type and/or phase (Pfister et al. 1974), and a preference index of elk use for each type. The Abla/Mefe, Abla/Xete/Vagl, and Psme/Caru types were most heavily used by elk. These three habitat types made up 67.1% of the transects, and incurred 69.9% of all elk use within the study area. However, of these 3 plant communities, only the Psme/Caru type was used by elk in excess of availability. Other types which were highly preferred by elk in Chamberlain Creek during the summer of 1975 were the Abla/Vagl, Psme/Feid, and Psme/Phma plant communities.

Generally, habitat types and phases which were preferred by elk during 1974 in Chamberlain Creek (Ellison 1975) were also preferred during the summer of 1975. Exceptions to this were the Abla/Vagl type which was highly preferred by elk during 1975, and the Abla/Caca type which was not. During the summer of 1974, the Abla/Caca type was preferred by elk, while the Abla/Vagl type was not. The more mesic (or wet) plant communities (Abla/Gatr and Abla/Caca) were more highly preferred by elk during 1974 than 1975. This decline in use by elk of wet areas, and increase in the use of more xeric sites during 1975 is probably attributable to unusually cool, wet weather last summer. Similar observations concerning summer habitat use by elk have been reported for the Bitterroot Valley of Montana (Marcum 1975).

A general description of elk distribution as determined by pellet densities along transects within the study area during 1975 is shown in Figure 1. The greatest elk use occurred at lower elevations, on dry slopes, at the north end of the study area. Since this type of data is difficult to evaluate numerically, and to compare yearly, in future years elk distribution will be defined by subunits within the study area.

Table 1. Elk use by habitat type (or phase) in the Chamberlain Creek Study Area during the summer of 1975.

	x % of Transect	y % Elk Use	y/x Preference Index
Abies lasiocarpa/Vaccinium globulare	0.2	0.9	4.5
Pseudotsuga menziesii/Calamagrostis rubescens	4.4	15.1	3.4
Pseudotsuga menziesii/Festuca idahoensis	2.2	7.2	3.3
Pseudotsuga menziesii/Physocarpus malvaceus	0.8	2.3	2.9
Pseudotsuga menziesii/Symphoricarpos albus	1.2	2.1	1.8
Abies lasiocarpa/Galium triflorum	0.8	1.1	1.4
Pseudotsuga menziesii/Vaccinium globulare	0.3	0.4	1.3
Abies lasiocarpa/Calamagrostis rubescens	0.9	1.1	1.2
Abies lasiocarpa/Menziesia ferruginea	30.6	31.1	1.0
Abies lasiocarpa/Clintonia uniflora - Menziesia ferruginea	0.4	0.4	1.0
Abies lasiocarpa/Linnaea borealis - Xerophyllum tenax	10.3	7.9	0.8
Pseudotsuga menziesii/Linnaea borealis - Symphoricarpos albus	0.5	0.4	0.8
Abies lasiocarpa/Xerophyllum tenax - Vaccinium globulare	32.1	23.7	0.7
Pseudotsuga menziesii/Carex geyeri	0.3	0.2	0.7
Pseudotsuga menziesii/Xerophyllum tenax - Vaccinium globulare	2.9	1.7	0.6
Abies lasiocarpa/Calamagrostis canadensis	6.3	3.2	0.5
Abies lasiocarpa/Linnea borealis - Linnea borealis	1.1	0.6	0.5
Pseudotsuga menziesii/Xerophyllum tenax - Arctostaphylos uva-ursi	0.8	0.4	0.5
Abies lasiocarpa/Xerophyllum tenax - Vaccinium scoparium	2.2	0.2	0.1
Meadow	1.1	0.0	0.0
Rock/Cliff	0.6	0.0	0.0

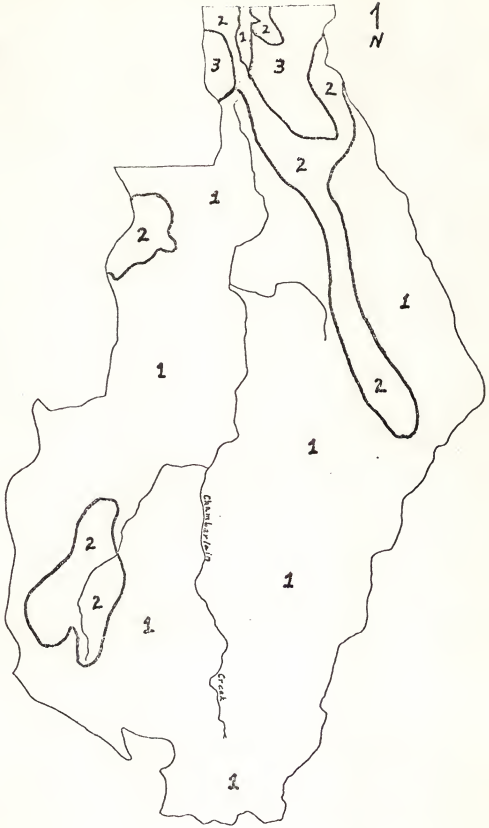

Fig. 1. Elk distribution within the Chamberlain Creek Study Area during the summer of 1975.

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Submitted by: C. Les Marcum

JOBS III - A-1 AND A-2

Progress Report for the Period
January 1-December 31, 1975

DETERMINE CHANGES IN HUNTER DISTRIBUTION, ELK BEHAVIOR AND HARVEST RESULTING FROM THE CLOSURE OF EXISTING ROAD SYSTEMS IN THE GRAVELLY MOUNTAINS OF SOUTHWESTERN MONTANA AND THE LITTLE BELT MOUNTAINS OF CENTRAL MONTANA.

The manuscript for the final report for these two projects is 80 percent completed and will be submitted for publication during the next report period.

JOB III-B

ELK USE OF DISTURBED AREAS

INTRODUCTION

The 1975 annual report for this job reported elk and deer use of 49 clearcuts in western Montana and presented graphic models describing that use. During the period since that report was prepared, some additional work on both the elk and deer models has been completed and a preliminary model for elk use of 38 clearcuts in eastern Montana has been prepared. The new analyses have produced minor modifications in the models presented previously and although the basic recommendations remain unchanged, some further discussion seems warranted.

METHODS

Data Collection

Data collection methods were described in detail in the 1974 and 1975 reports. In brief summary, elk and deer pellets were counted on 0.02 a plots spaced at 100-foot intervals along transects crossing clearcuts and running 500 feet into the uncut surrounding forest. In addition to numbers of pellet groups, a variety of independent variables describing the size and shape of the clearcut and the amount of vegetation, slash and down timber were recorded.

Analyses

Analysis of all data available has not been completed, and these initial analyses are based only on means for each clearcut sampled. Conventional regression modelling techniques were applied to the data, but the relations developed were weak and uninformative because of complex interactions between elk and various components of their environment. As an alternative, direct graphic exploitation of the data has been undertaken. Methods for graphic development and subsequent mathematical specification of the graphic model are explained by Hensen and Homeyer (1970, 1971) and Jensen (1973). Constraints imposed by this technique include reasonable biological expectation and the sacrifice of probabilistic evaluation. In addition, subjective judgements can affect results although it appears likely that similar models would be obtained by equally experienced analysts.

Western Montana Elk Model

One example of the changes in model structure resulting from slightly different subjective judgements is provided by the western Montana elk model. In the expression presented in the 1975 report, similarity to the highly successful deer model was assumed and elk use was modelled as a sigmoid function over acres with peak use around 60 acres. An interaction with dead and down timber was suggested by a shift in this peak down to about 20 acres as down timber around the opening increased in depth. This model had an estimated $R^2 = 0.40$.

Further analysis in compiling the model for publication[1/] suggested that the sigmoid curve of elk use over acres could just as logically peak at zero. And, this change did, in fact, produce a minor improvement to R^2=0.42. Thus, the model presented in figures 1 and 2 is slightly different than the model presented previously.

Two important points should be noted with regard to this change. First, this revision demonstrates that it is not necessarily possible for the modeller to arrive at the very best fit in the model finally selected. There may, in fact, be other possible configurations which would further improve the estimated R^2 for these data. It is even conceivable that a different analyst might concentrate on variables other than those selected here and get an entirely different model.

On the other hand, it is also important that all relationships and interactions suggested by the original model remain essentially unchanged and the implications for forest management are the same as previously indicated. This result would have been obtained in any model using the four variables selected here.

In summary: elk do not frequent clearcut areas in western Montana until vegetation has developed. Given openings under 60 acres, a minimum of residual logging slash in the opening and a minimum depth of dead and down timber outside the opening, elk presence increases with vegetation height, reaching a peak when vegetation becomes four feet high. Elk response to vegetation height, however, is diminished substantially when opening size exceeds 100 acres, slash inside the opening exceeds 1.5 feet in height, and dead and down timber materially exceeds 1.5 feet. It is not possible to demonstrate that openings of any size are clearly beneficial to elk. Neither is it possible to demonstrate detrimental effects of small openings. Where the adjacent forest is relatively clear of understory debris, openings up to 100 acres may be acceptable although small openings are still preferred. Use of any opening by elk will remain low until vegetation reaches at least 2 to 3 feet in height.

Western Montana Deer Model

Concurrent with the revision of the elk model, the deer model presented in 1975 was reexamined and a slightly better fit obtained. Increased complexity of the mathematical expression raised the estimated R^2 from 0.71 to 0.74. As with the elk model, all relationships and interactions were consistent with the previous model and implications for forest management remain exactly the same. Changes in the model were mostly subtle expressions of deer behavior, and since no major management implication is involved the model is not presented in this report.

1/ See Proceedings of the Elk-Logging Symposium, University of Idaho, Dec. 1975.

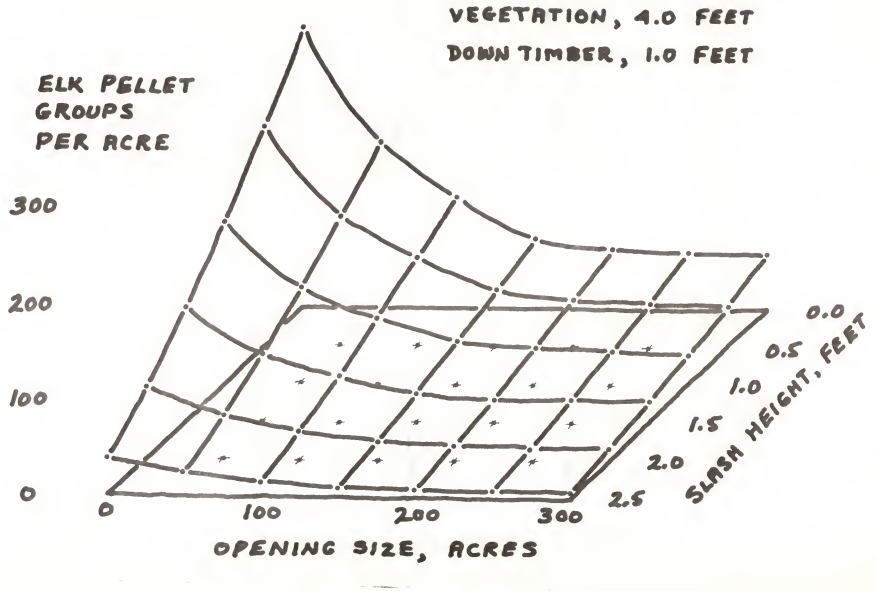


Figure 1.--Submodel of surface showing relationship between elk pellet densities and four variables.

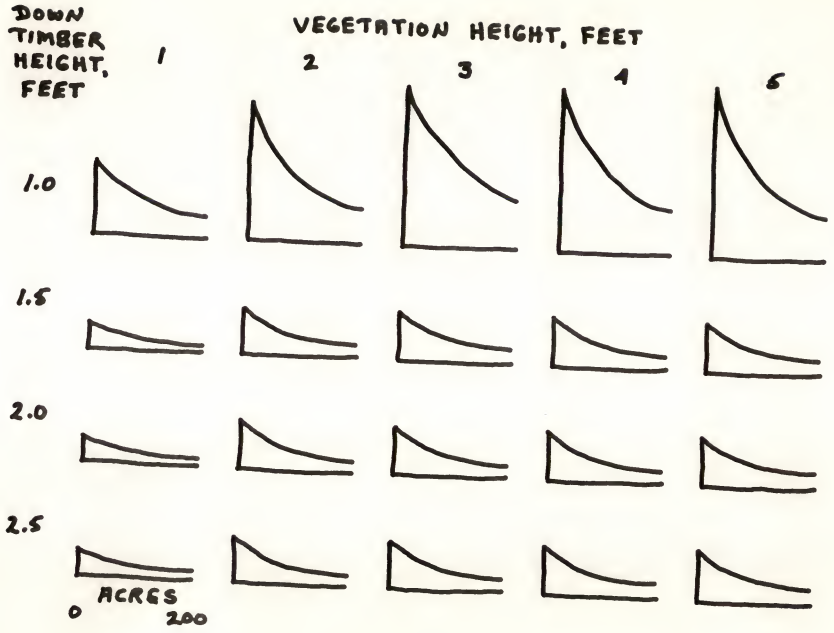


Figure 2.--Submodels for elk pellet densities with no slash in the opening.

Eastern Montana Elk Model

During the summer of 1975 pellet-count data were collected on 38 clearcuts and 9 natural openings in Montana East of the Continental Divide. This sample and a separate analysis were considered advisable because Eastern Montana elk habitat has large numbers of natural grassland openings, timber of far lower basal area and forest communities of strikingly lower complexity than most of the elk habitat in western Montana. Our assumption that the behavioral responses of elk exposed to an entirely different environment than that which produced the western Montana model has been more than justified by the initial results.

In analysing the data for the 38 clearcuts, the approach used was the same as already described for western Montana data in previous reports. A regression screen predicting elk-pellet densities inside openings and presuming linear additive effects of independent variables provided an estimated $R^2 = .69$ with the best six independent variables. However, the three most important variables were pellet counts: elk outside, deer inside and deer outside. Three environmental variables (cover outside, slash inside, down timber) actually provided little additional information. A second regression screen without the three pellet variables provided an $R^2 = .20$ with three independent variables, but slash inside was dropped in favor of the ratio between perimeter and area. In summary, the regression screens supplied little usable information other than suggesting four variables with possible weak linear effects and demonstrating the probability of strong interactions and curvilinear influences more complex than reasonable pre analytic specification.

Accordingly, and again on the basis of more or less subjective judgements by the analyst, various combinations of independent variables were examined by graphic methods to derive what appears to be a logical initial model describing elk use of clearcuts in eastern Montana. The four variables found to be important in western Montana (vegetation inside, slash inside, down timber, and acres) were examined independently and in combination, but only one (vegetation inside) appeared to have much influence on elk use. Surprisingly, however, the relationship between elk use and vegetation height inside the opening was negative rather than positive as indicated for western Montana. At the same time, a positive relationship for cover quality around the opening was indicated, and a strong interaction between altitude and all other independent variables was detected. Most important, however, a completely unexpected interaction involving altitude, vegetation height in the opening and motor vehicle access was discovered. Size of opening, slash inside, and down timber outside, contrary to expectations suggested by the western Montana model, contributed little improvement to the fit between the model and the data. A first approximation model, presented here as figures 3 and 4, has an $R^2 = 0.75$ when fitted back to the data from which it was derived. The four variables on which this model is based are:

1. Altitude. In this sample ranging from 6000 to 7800 feet.

FIGURE 3. - ELK USE OF CLEARCUTS WITH NO MOTOR VEHICLE ACCESS

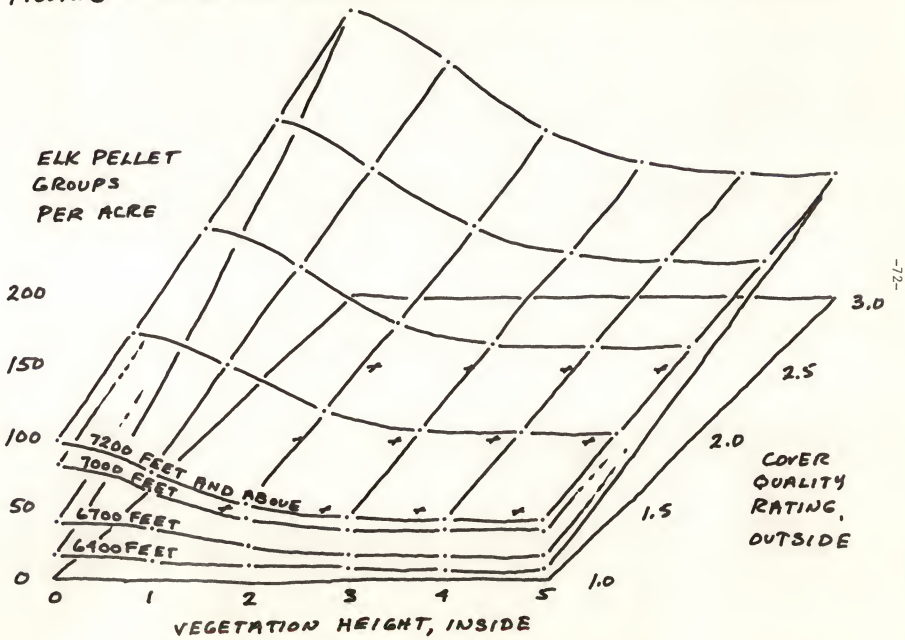
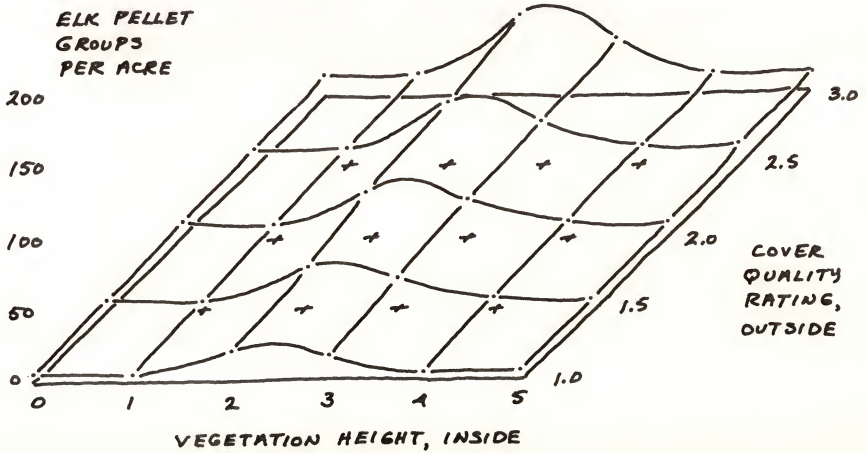


FIGURE 4.- ELK USE OF CLEARCUTS WITH MOTOR VEHICLE ACCESS (7000 FEET ONLY)



2. Cover outside. A subjective judgement rating of cover quality on each sample plot in the uncut forest around the opening. A rating of 2 was given normal or average forest cover. Where fewer trees and a lack of understory gave an impression of thin or inadequate cover, a 1 rating was recorded; and where dense regeneration or conifer branches to ground level were present a 3 rating was assumed.

3. Vegetation inside. The average height of the tallest vegetation on sample plots.

4. Access. A classification variable, essentially binomial. Openings were either accessible by vehicle or only accessible on foot.

Discussion

Of the four independent variables represented in the eastern Montana model, only one is under the immediate control of the land manager. Nevertheless, all four have implications that could be important in decision-making.

The influence of altitude in this model appears to be an expression of animal movement from low altitude winter ranges to higher altitudes in the summer. In general, clearcut openings above 7000 feet were more heavily used by elk. The implication, at least, is that management activity above 7000 feet is likely to have more influence on elk populations than activity at lower altitudes. Since any activity on the winter range is also likely to influence elk populations, the interim range of reduced influence may be relatively narrow.

At any specified altitude, elk use of openings is further modified by the interacting influences of vegetation both inside and outside the cut and by the amount of vehicle traffic in or near the opening. My initial explanation of these relationships depends on two assumptions about the environment available to elk in eastern Montana:

> First, most of the elk herds in the areas sampled are found, at one or more times during the year, on grassland ranges or at least on forested land with a variety of natural openings. Thus, these animals are behaviorally conditioned to accept openings without cover as one of the places where primary feeding activity takes place.
>
> Second, the habitat types sampled in eastern Montana largely consist of a grass-forb understory and a tree overstory without any major component of shrubs. Any vegetation over two feet tall as measured in this study is likely to consist entirely of trees.

In the context of these assumptions, it may not be completely surprising that increasing vegetation height inside the opening is correlated with a reduction in elk use. In the absence of shrub development, the grass-forb understory may be the only thing attracting elk to openings in these types. Thus, the shade produced by trees, in reducing

the growth of forbs and grasses, would also remove the only reason elk have for entering the opening.

At the same time, the importance of secure cover adjacent to the opening is apparently enhanced by the fact that the opening offers no cover during the period it is attractive to elk. Depending on altitude, because adjacent cover is somewhat more important below 7000 feet, an opening with poor adjacent cover would receive only about one-third as much use by elk as a similar opening surrounded by dense cover. The relationships of the two vegetation variables and altitude are illustrated in figure 3.

From a management standpoint, there is probably little that can be done to improve cover quality where it doesn't exist. On the other hand, the layout of clearcuts can be designed or modified so that the best available cover occurs at the edge of the opening. In addition, it seems obvious that thinning adjacent to a clearcut should be postponed until regeneration within the opening has reduced its potential value for elk.

The fourth variable in the eastern Montana model is, without much question, the most important--both from the significance of its effect and because it is readily controlled by the manager. Figure 4 demonstrates the influence of vehicle access on elk use of clearcut openings at or below 7100 feet. Above 7100 feet figure 3 applies whether there is vehicle access or not. Below 7100 feet, figure 3 applies to openings with no vehicle access but figure 4 describes elk use of openings which can be reached on a road.

Despite an obvious split in the data for this study, it is fairly certain that the 7100 foot level is not an absolute breaking point for this relationship. Rather, it is suggested that 7100 feet may be about the average altitude at which spring snow drifts, long standing mud holes, early snow fall and reduced road maintenance combine to cut down the total flow of vehicular traffic. It also appears to be a reasonable assumption that roads at higher altitudes will more often be dead end roads leading only to the sampled clearcuts.

With regard to figure 4 and those lower altitude openings with ready access for motor vehicles, the altitudinal influence and the requirement for quality cover adjacent to the opening still apply. However, the influence of vegetation height inside the opening appears to be a derived compromise. Elk do not use openings without internal cover because of vehicle influences, and there is no reason for them to enter openings in which tree cover has fully developed. Thus, the peak use period for this particular situation occurs during the brief span of time when regeneration heights are almost adequate to provide cover but not quite enough to have shaded out the forb-grass understory.

Tentatively, at least, it can be suggested that this interaction provides a very high potential for management actions intended to increase summer elk use of clearcut openings below 7100 feet.

DISCUSSION AND CONCLUSIONS

Certain characteristics of animal behavior, such as sociability herding instinct and breeding patterns are probably consistent for a species independent of environment. Other characteristics of behavior demonstrate a learned response to environmental conditions as they exist during the lifetime of the individual. In the two models of elk behavior presented in this report, learned response to at least two broadly different kinds of environment is illustrated. That a lack of consistent behavior by elk in all environmental situations will complicate land management decisions is more than obvious. Nevertheless, the forester need only consider the behavior of Monterey pine to recognize that biological reality is only inconsistent where we don't understand it. In this report I am assuming that logical explanations for the differences between the two models do exist. Moreover, I am obligated to suggest that these two models only reveal the gross manifestations of a whole continuum of behavioral patterns. As further information is obtained from continuing studies, it appears very likely that even more complex relationships will be discovered.

At this stage, the two models of elk response to clearcuts are based on seven independent variables that assume greater or lesser degrees of importance depending on the existing structure of the environment and the experience of animals in that environment. Selection of the appropriate model for any specific situation depends on some prior knowledge of existing elk habitat and may involve combinations of patterns taken out of both models. It may eventually be possible to derive a model which takes external factors of environment into account, but such a model might also be too complicated to have any practical application. The following are suggested as interim guides:

Slash. There is little reason to suspect that elk response to slash is not consistent throughout elk summer range. The fact that slash was not indicated as important in the eastern Montana model is a function of the available samples. Eastern Montana forests simply produce less slash, and the available sample had few clearcuts in which slash was deep enough to effect elk use. In general, slash over 1.5 feet will cause a depression in elk use of openings.

Dead and down. Apparently the same relationship exists as noted for slash. The smaller stems and shorter crowns of eastern Montana timber produce less of a barrier to elk movement.

Altitude. Few western Montana elk herds exhibit the strong vertical migration patterns of eastern Montana herds. Evaluation of this variable should be determined on individual herd basis.

Vegetation, opening size and access. In their various combinations, these variables can be interpreted as expressions of the relationships between feeding activity and the need for security during the feeding period. All are important to elk, but the relative significance of any particular variable will change as a function of habitat type. At this point, only

the extremes have been described, but the local manager can certainly interpolate between these extremes to fit the situation.

Grass-forb habitat types, represented by the eastern Montana model, provide forage in the opering as long as cover (trees) is not present. Security, in the form of good cover around the opening and poor vehicle access to the opening, controls the amount of use by elk.

Shrub-browse habitat types, represented by the western Montana model, provide security inside the opening with a resulting lesser influence of factors external to the opening. Cover around the opening and access control are probably important--but far less so than in grass-forb habitat types.

In all situations, the size of the opening, vehicle access and available cover are keys to secure use of the forage by elk, but the relative importance of different kinds of security will vary for each situation.

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APPENDIX

APPENDIX I

During the report period one Ph.D. thesis was completed for a job associated with the elk-logging study; following is the abstract:

Marcum, C. Les. 1975. Summer-fall habitat selection and use by a western Montana elk herd. Ph.D. Thesis, U. of Mont., Missoula. 188 pp.

Summer-fall habitat selection and use by a western Montana elk herd were investigated from 1971 through 1973. Objectives were to evaluate the interrelations between elk and various biological and physical habitat factors. Habitat use was determined by obtaining locations of radio-tagged elk. Habitat selection was determined by testing for statistically significant differences between the use of various environmental situations by elk and the availability of those situations within the study area. Habitat factors generally used by elk in excess of the availability of those factors were identified as (1) *Pseudotsuga menziesii/Calamagrostis rubescens* and *Abies lasiocarpa/Galium triflorum* habitat types; (2) slopes on southwest and south aspects; (3) gentle (0-15°) slopes; (4) drainage bottoms and upper slopes; (5) elevations of 5,350 to 6,349 feet from an available range of 3,850 to 7,900 feet; (6) an overstory canopy cover of 26-75 percent; and (7) areas within 150 yards of water. Also, when in openings, elk preferred areas near timber, but lands within 100 yards of ecotones were used in excess of availability only during 1973. Between-year and seasonal differences in habitat use and in some cases, selection by elk varied substantially, and were largely attributed to direct or indirect influences of weather. Sexual differences in habitat use were related to giving birth and tending newborn calves by cows.
Use of areas on or within 550 yards of open system roads, and clearcuts by elk was significantly less than the availability of those areas. Elk were displaced by logging activities at higher elevations on their summer-fall range, and from roads open to vehicular traffic during hunting seasons. Much of the displacement of elk from open roads during hunting seasons was in excess of 1 mile. They also made greater use of heavily forested areas during hunting seasons. Partially logged areas were more readily used by elk than clearcuts, and areas where roads were closed to vehicular traffic received greater use than areas where roads remained open.

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